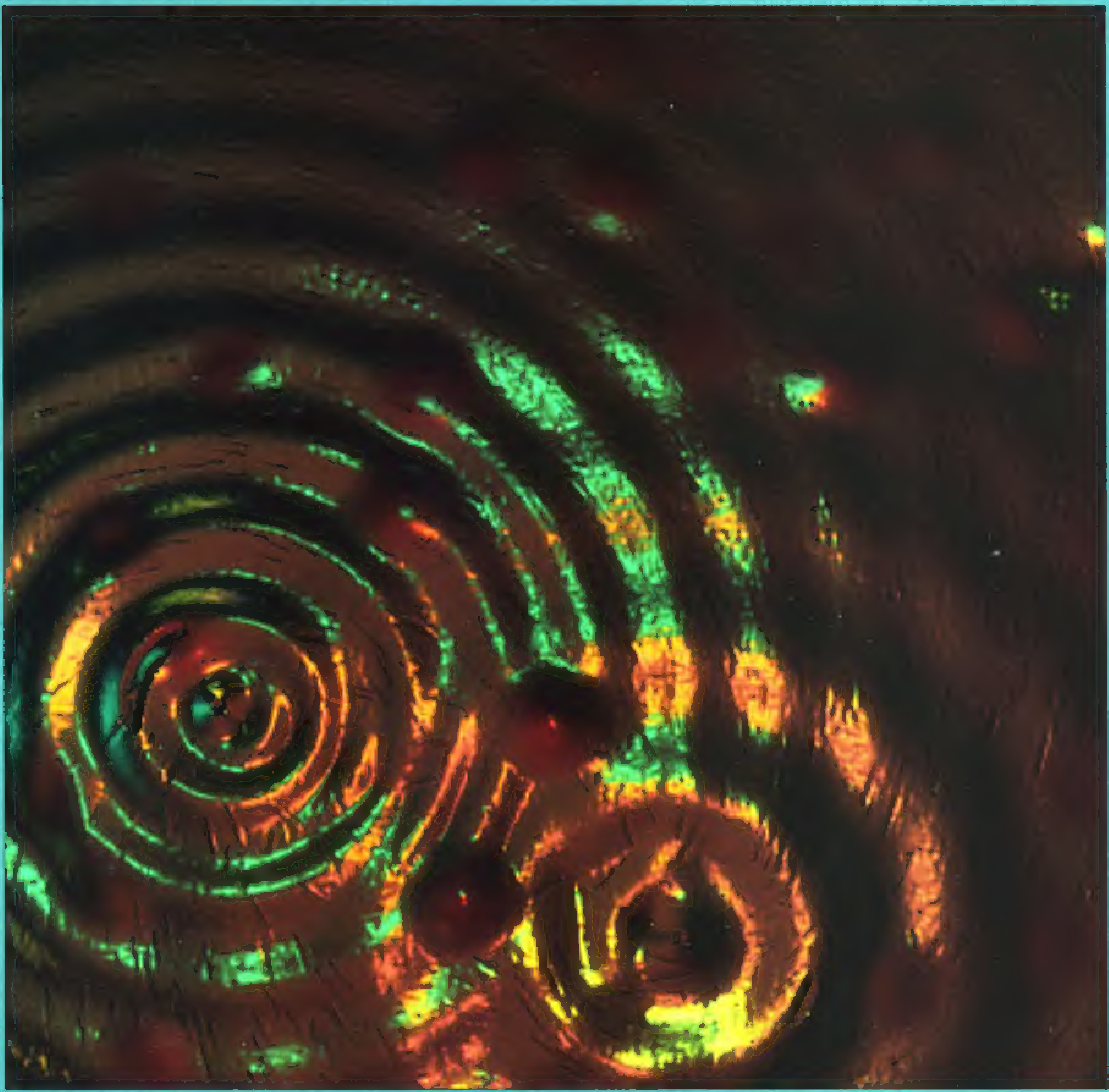
THE MAGAZINE OF VISUAL PROCESSING

NUMBER FIFTEEN/FOUR DOLLARS

IRIS

universe™



WINNERS OF THE FIRST INTERNATIONAL VISUAL PROCESSING AWARDS

VISUAL COMPUTING IN AUSTRALIA, ENGLAND, FRANCE AND BEYOND

THE MAKING OF A FLIGHT SIMULATOR

To save time.

0.000	0.000	0.000	0.000	0.000
0.000	-13.516	-6.158	0.374	-3.199
0.000	-12.069	-8.037	1.078	-2.975
0.018	-9.722	-12.263	0.620	-2.631
0.497	-3.189	-11.245	0.890	-2.340
0.427	-3.600	7.234	-4.837	-1.049
0.000	-25.560	5.720	-1.062	-0.443
0.000	-22.133	6.017	0.036	-0.476
0.000	-20.055	7.025	-0.695	-0.457
0.000	-19.844	7.802	0.589	-0.458
0.000	0.000	0.000	0.000	0.000
0.000	-12.828	-3.820	-0.157	-3.460
0.000	-11.598	-6.443	-0.075	-2.923
0.058	-12.361	-9.148	-0.316	-2.296
1.883	-8.944	-10.794	-1.030	-1.727
0.070	-16.862	-8.708	-0.144	0.097
0.000	-24.751	0.526	0.669	-0.247
0.000	-21.240	4.779	0.036	-0.253
0.000	-19.399	7.124	0.073	-0.288
0.000	-19.455	8.180	0.107	-0.277
0.000	0.000	0.000	0.000	0.000
0.000	-11.694	-0.869	0.346	-3.462

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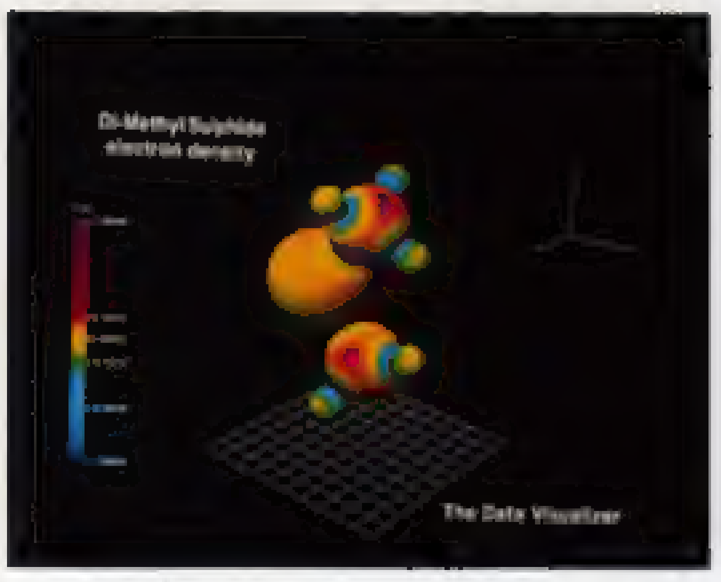
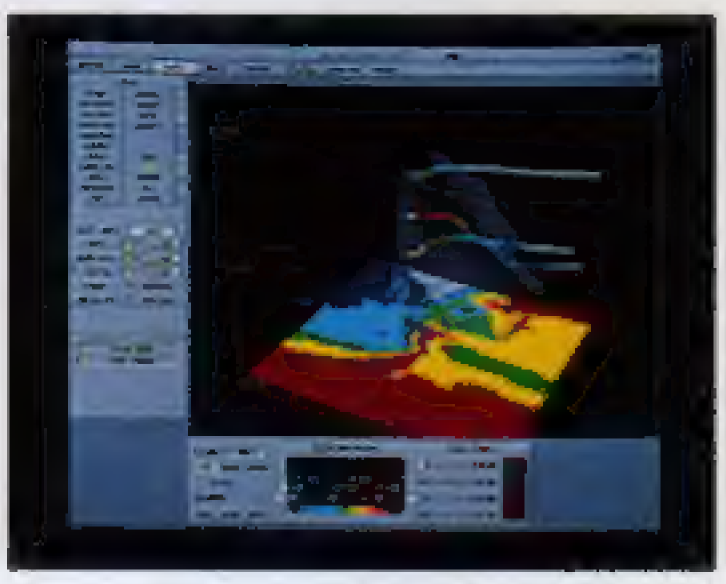
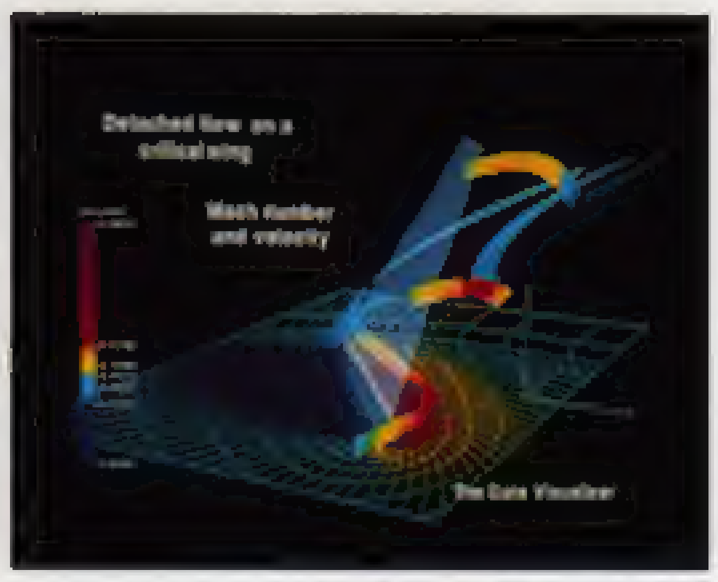
Picture this.







To make sense of all the numeric data churned out by workstations, supercomputers, satellites and scientific instruments you could work a 48 hour day.

A computer generates millions of bits of data and computes solutions to thousands of equations. The resulting avalanche of information can overwhelm traditional interpretation techniques. Without a time-effective method of transforming these results into pictures, you won't know what you're missing.

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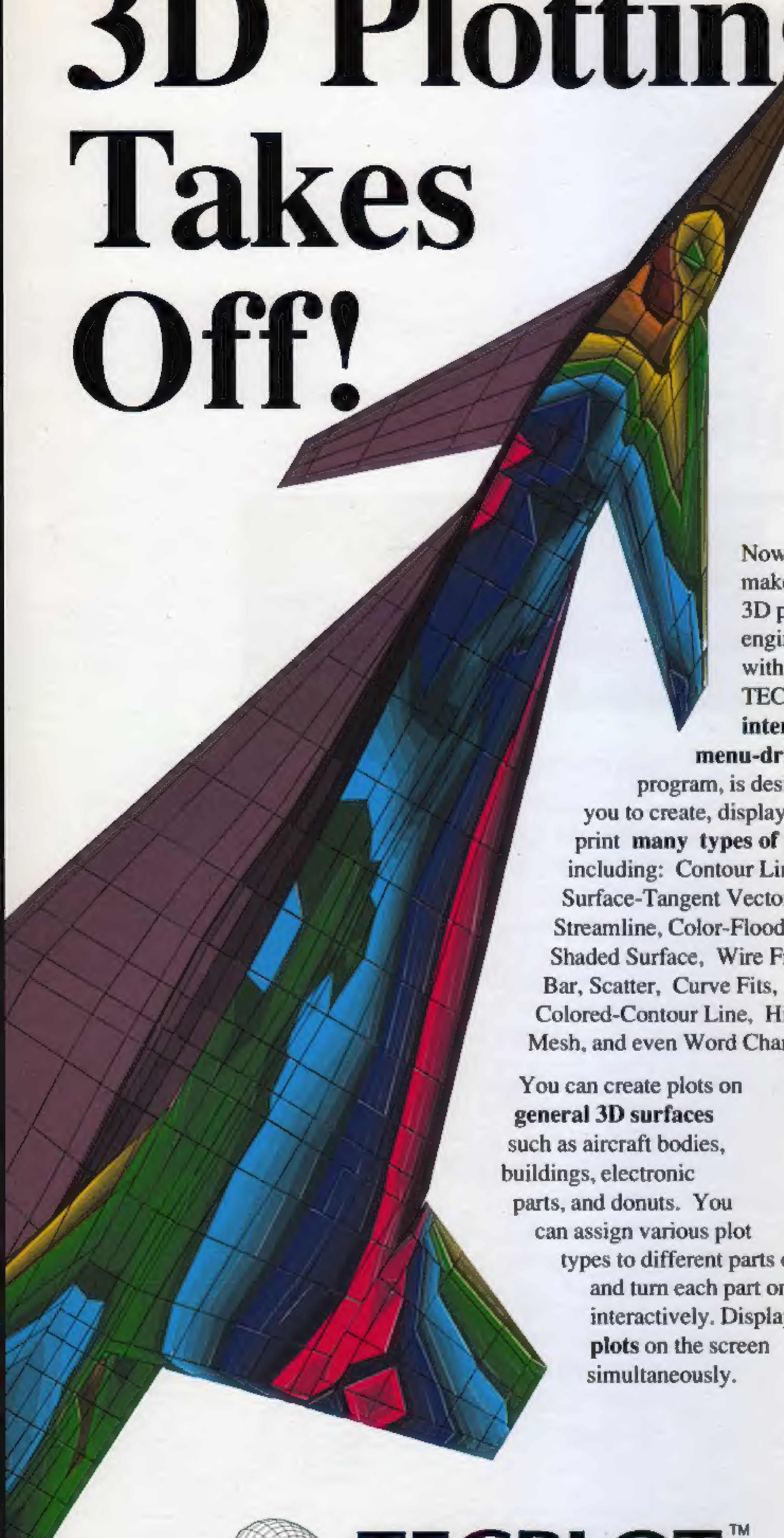

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Now you can make complex 3D plots of your engineering data with **ease**. TECPLOT, an **interactive menu-driven** program, is designed for you to create, display, edit, and print **many types of plots** including: Contour Line, Vector, Surface-Tangent Vector, Streamline, Color-Flooded Contour, Shaded Surface, Wire Frame, XY, Bar, Scatter, Curve Fits, Colored-Contour Line, Hidden-Line Mesh, and even Word Chart.

You can create plots on **general 3D surfaces** such as aircraft bodies, buildings, electronic parts, and donuts. You can assign various plot types to different parts of your data, and turn each part on or off interactively. Display **multiple plots** on the screen simultaneously.

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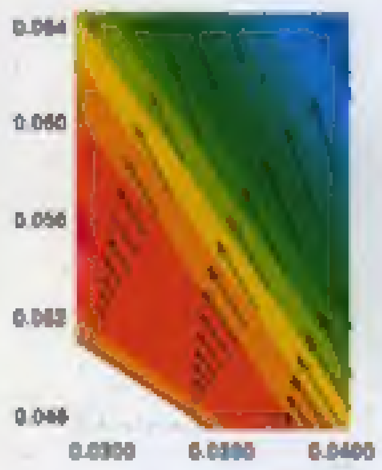

TECPLOT is especially suited for visualization of data generated by finite-element and finite-difference applications (such as **Computational Fluid Dynamics**). Other features include data manipulation functions, macros, interactive extraction of data, least-squares curve fits, splines, text with Greek and mathematical symbols, drawing tools, and control over most plot details.

TECPLOT Version 4.0 is currently available for most unix workstations including the **Silicon Graphics IRIS**.

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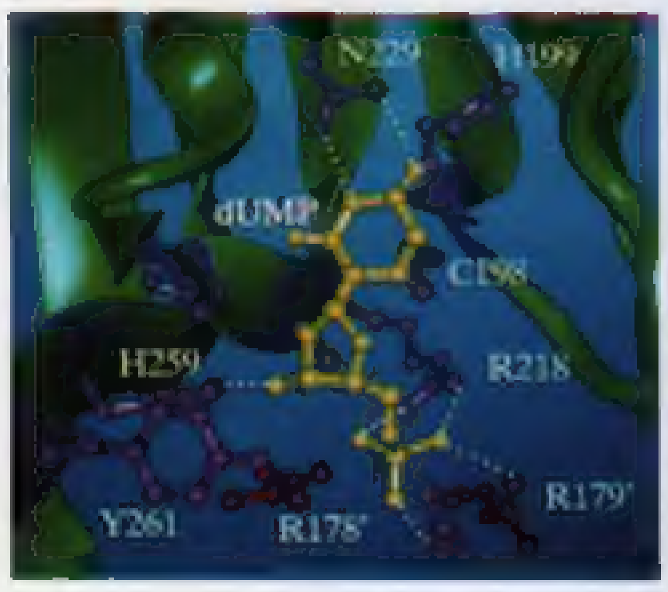
THE MAGAZINE OF VISUAL PROCESSING

ISSUE NUMBER FIFTEEN



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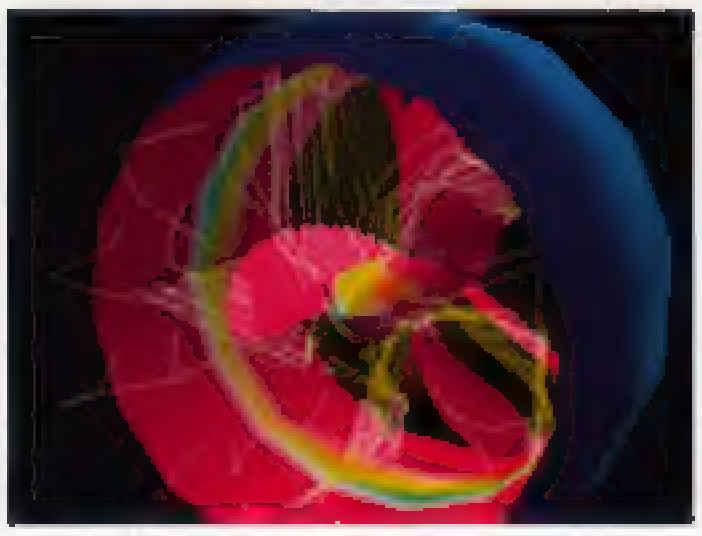

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FEATURES

DEPARTMENTS

ON THE COVER
One of the many worthy entrants in the First International Visual Processing Awards. This is one frame from an animation, depicting "currents embedded in a viscous flow with various wave sources and surface erosion." Created on an IRIS 4D/25 workstation at XAOS Computer Animation and Design in San Francisco, California.

Optical Storage Subsystems You Can Build On

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Editor Douglas Cruickshank

Contributing Editors Gaye Graves, Pramod Rustagi

Design Francesca Angelesco

Digital Images Monica Schulze and Paul Haeberli

Typesetting Lauren Langford Typography

Color Separations American Color

Printing The Press

Editorial Silicon Graphics, Inc.
2011 N. Shoreline Blvd.
Mountain View, CA
94039
415/335-1727

Circulation Monica Schulze
Silicon Graphics, Inc.
2011 N. Shoreline Blvd.
Mail Stop 415
Mountain View, CA
94039
415/962-3320
<monica@sgi.com>

Advertising Ardith Lowell
MKT.
2755 Campus Dr. #247
San Mateo, CA
94403
415/341-9681

Publisher Mark Compton

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THE IRIS UNIVERSE AND THE *IRIS UNIVERSE*

"By definition there can only be one universe."
— Carl Sagan

I hate to be the one to break it to you Mr. Sagan, but you're wrong. The IRIS universes are rapidly expanding and evolving. I refer to both this magazine, which we know as *IRIS Universe*, and that conceptual place — the universe of IRIS workstation users. We consider those users our constituency, and gauge the success of this magazine according to how well it reflects their interests, concerns, and accomplishments.

So, as the IRIS universe changes, the *IRIS Universe* must also change. As visual processing workstations become ubiquitous and their areas of application become more diverse, we continually seek to enlarge the scope of the magazine.

Some changes are obvious. So much is happening in the IRIS universe these days that it simply takes more pages to provide adequate coverage. Consequently we've increased the magazine's page count. To accommodate the new size, and to give the publication greater permanency, we've changed to book-type binding.

Some of the most important changes may not be noticed at first glance. IRIS workstation users are eager to hear news of their counterparts around the world. From now on *IRIS Universe* will reflect the worldwide impact of visual processing. In this issue we take you to Australia, France, and England. Henceforth each issue will carry in-depth accounts of the fascinating work being done in every corner of the globe with computer visualization technology.

In addition, the magazine will continue to carry articles featuring "tricks of the trade" — such as "Solutions" — as well as coverage of exciting new products — such as IRISVISION and IRIS Showcase.

Like the IRIS universe, the *IRIS Universe* is constantly growing and changing. As always, we are interested in your comments, ideas, and suggestions in regard to both universes.

—Douglas Cruickshank, Editor

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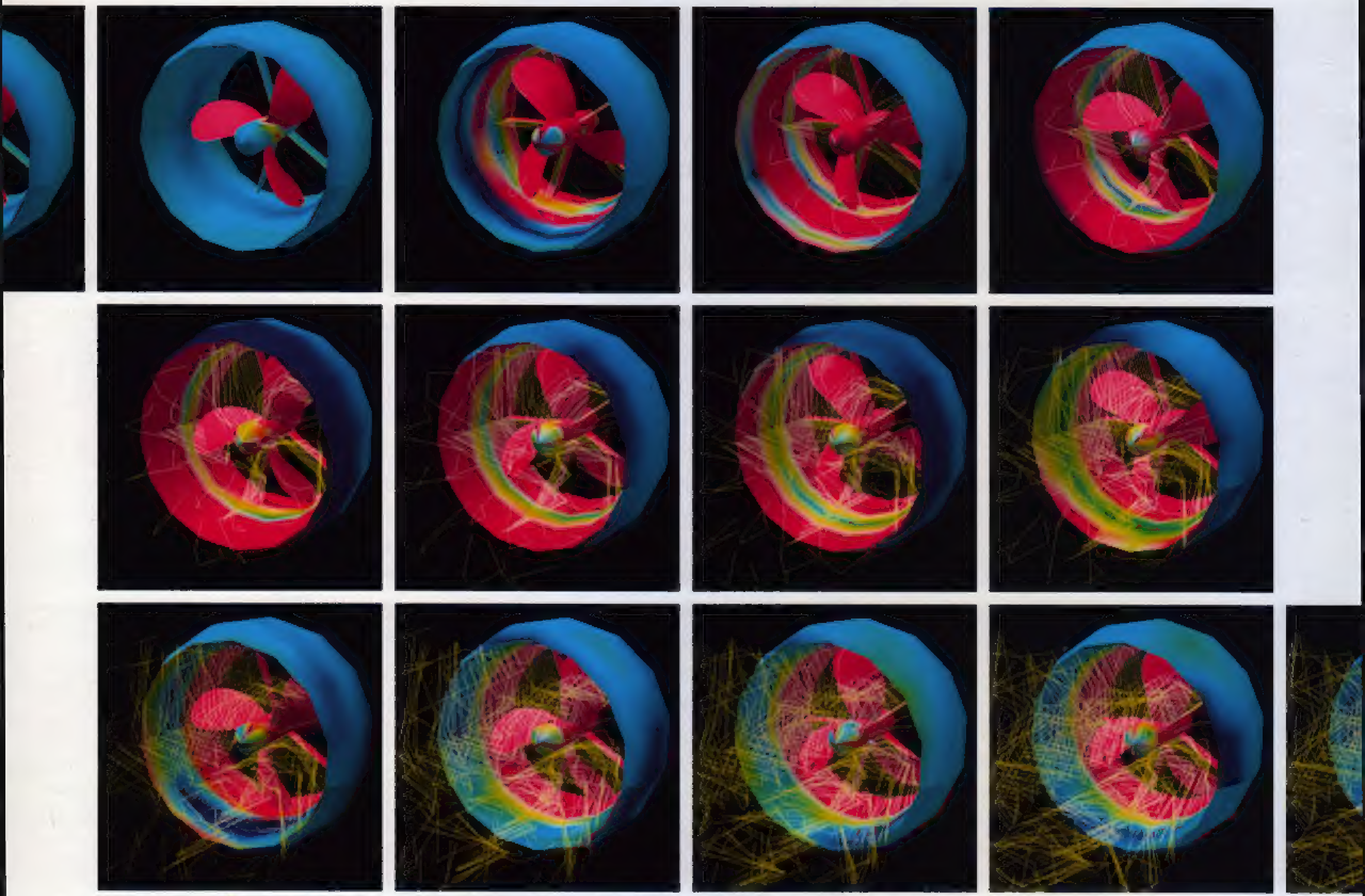
BY STANLEY POSEY



This sequence displays the time-dependent pressure solution and wake streamlines of a rotating, ducted propeller fan. The computational fluid dynamics (CFD) calculation technique illustrated in the sequence can assist designers in analyzing the performance of various fan designs for optimum shape, pitch and blade angle. This calculation demonstrates the effective use of CFD in eliminating poor design candidates early in the design cycle.

The software used to create this sequence, OMNI3D™, is an interactive software system that assists fluid dynamics professionals in visualizing results from CFD simulations. OMNI3D was developed by Analytical Methods Inc. to provide post-processing capability for solutions generated from the company's CFD solvers, VSAERO™ and USAERO™.

The calculations were performed on an IRIS Power Series™ workstation with USAERO, an unsteady aerodynamics flow solver. The solution technique developed in USAERO has its foundations in the panel method descritization-scheme, meaning that the generally non-linear equations that govern fluid flow are reduced to a linear form owing to a series of simplifying physical assumptions. Because of their numerical simplicity, panel methods offer a tremendous advantage in the modeling of complex geometric configurations since many panels can be generated to describe a geometry while the cost of the calculation increases very little.

Thermodynamic efficiency of a ducted fan system is determined by the ratio of the useful work produced by the system which might be thrust, to the amount of work needed to power the system such as an electric generator driving a rotating shaft. This ratio is always less than one owing to aerodynamic drag losses that occur during operation as the fluid moves over the various surfaces. The amount of aerodynamic loss can be directly correlated to the geometry of the fan blade so that several blade geometries might be evaluated before efficiency is maximized.

Stanley Posey is in the Computational Fluid Dynamics group at Silicon Graphics. ●

GET IT ON TAPE

SEEING IS BELIEVING

From computer to video - Lyon Lamb's real-time converter (RTC) will transform your graphics into superior NTSC or PAL video. No pixel loss. Enhanced detail. Vivid Clarity. Plus you'll enjoy total flexibility with automatic lock-up to virtually any computer.

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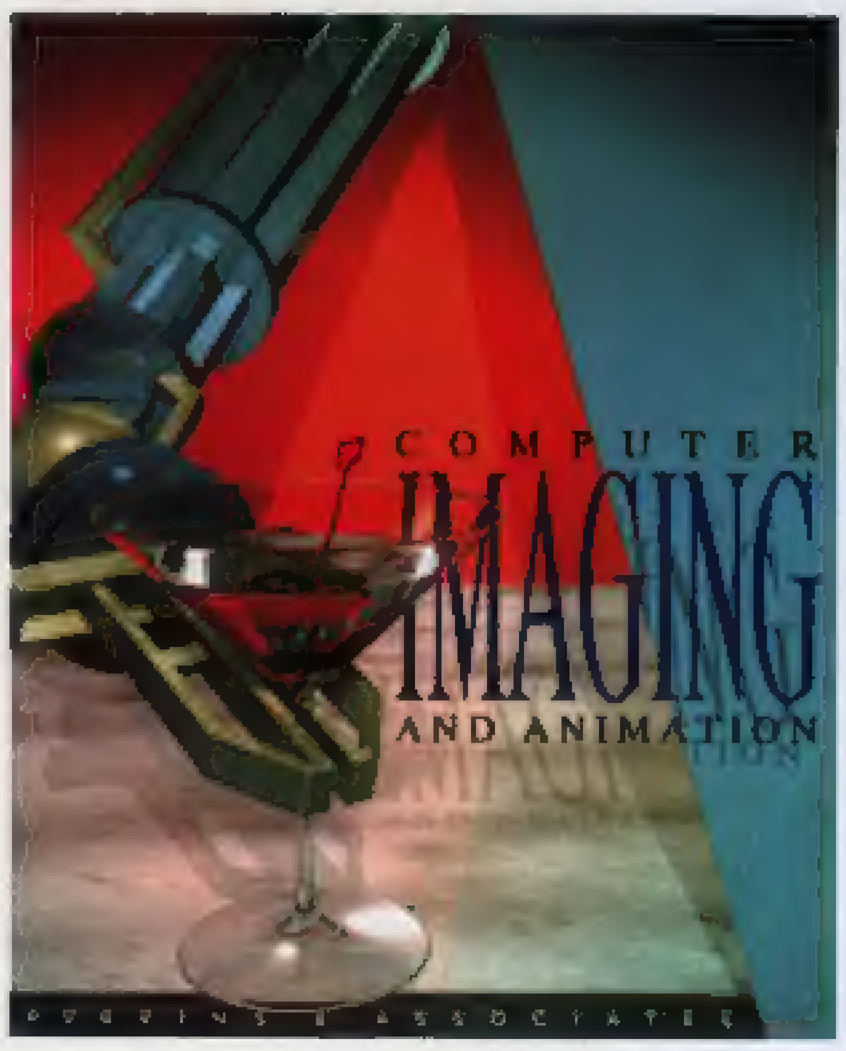
BEST SHOTS

Winning Images from the First International Visual Processing Awards

Industrial Design and Product Design *(Overall Winner):* "Prototype Model of a Helicopter." Generated by Softimage running their software on a Personal IRIS 25 workstation with 16 megabytes of memory at a resolution of 2K. The image took four hours to create with an oversampling of twenty-five pixels. The model has fifty moving parts, 180,000 triangles, and is fully ray-traced — note the reflection of the rotor-blades in the window. The body of the helicopter — stripes, etc. — was painted using positioning techniques with transparency mapping. The water surface was done by using procedural texture with bump mapping and reflection mapping.

Architecture, Construction, and Engineering *(Runner-up):* "Rendering of an Architectural Concept," created for a thesis project by Mark Edwards, CADAIM Ltd., England, using Sonata software on an IRIS 4D/20 workstation.

Publishing: "Computer Imaging and Applications Self-Promotional Poster," created by Perkins and Associates on a Personal IRIS workstation, using the Softimage 4D Creative Environment. All of the elements in the image were modelled polygonally. The martini glass was built as a patch model. This permitted easier adjustment of its shape and resolution during the design process. The completed image, rendered at a resolution of 4K, contained 150 models and 39,605 polygons. Design and layout by Kenn Perkins. Modelling, material definitions, and rendering by Jim Perkins.



Animation and Graphic Arts: Industrial Light & Magic. This is a composite image: the hotdog and terrain were filmed in a studio, the ants were modelled on a 4D80/GT IRIS workstation and rendered on an IRIS 240 workstation, using software by Alias (for modeling) and Reyes (for rendering). Executive Producer, Computer Graphics: Nancy St. John, Computer Graphics Animation Director: Steve Williams, Visual Effects Supervisor: Jay Riddle; Producer Clint Goldman; Director: Jim Money Copyright ©1990 LucasArts Entertainment. All rights reserved. Courtesy Industrial Light & Magic

Scientific Visualization, Earth Resources Management, Geological Sciences, Life Sciences: "Growth Simulation of a Begonia 'Elithe'." Rendered in ten minutes on an IRIS 4D/20 workstation running AMAP. From CIRAD Laboratoire de Modelisation, Montepellier, France

You don't need a doctorate in computational fluid dynamics to recognize that the rendering at top right of an F-18 jet from NASA Ames Research Center is a striking accomplishment. Likewise, one need not know an enzyme from an end zone to be impressed by the detailed image of thymidylate synthate created at the University of California, San Francisco.

All 300 of the images submitted to the First International Visual Processing Awards were winners. That's what made it so difficult for the judges to pick just ten — one to represent each of this year's categories: Animation and Graphic Arts; Architecture, Construction, and Engineering; Publishing; Computational Fluid Dynamics; Computer Aided Molecular Design; Image Processing and Medical Imaging; Industrial Design and Product Design; Mechanical CAE, CAD/CAM; Scientific Visualization, Earth Resources Management, Geological Sciences, Life Sciences; and Visual Simulation. It's likely that the categories will be expanded for the 1991 competition.

The competition — an annual event — recognizes creativity and excellence achieved in visual processing using Silicon Graphics workstations. A winner is chosen in each category, with the Overall Winner and the Runner-Up receiving cash awards. Silicon Graphics congratulates the winners of this year's competition and extends a warm thanks to all who entered.

An entry form for the 1991 competition is located on page 11. ●

Computational Fluid Dynamics: "An F-18 Computational Model, Displaying Particle Traces, Oil Flow, and Helicity Contours," by Chris Gong and Ken Gee, NASA Ames Research Center, Workstation Applications Office. Created with GAS (Graphics Animation System), SURF, and PLOT3D on an IRIS 4D/70GT workstation

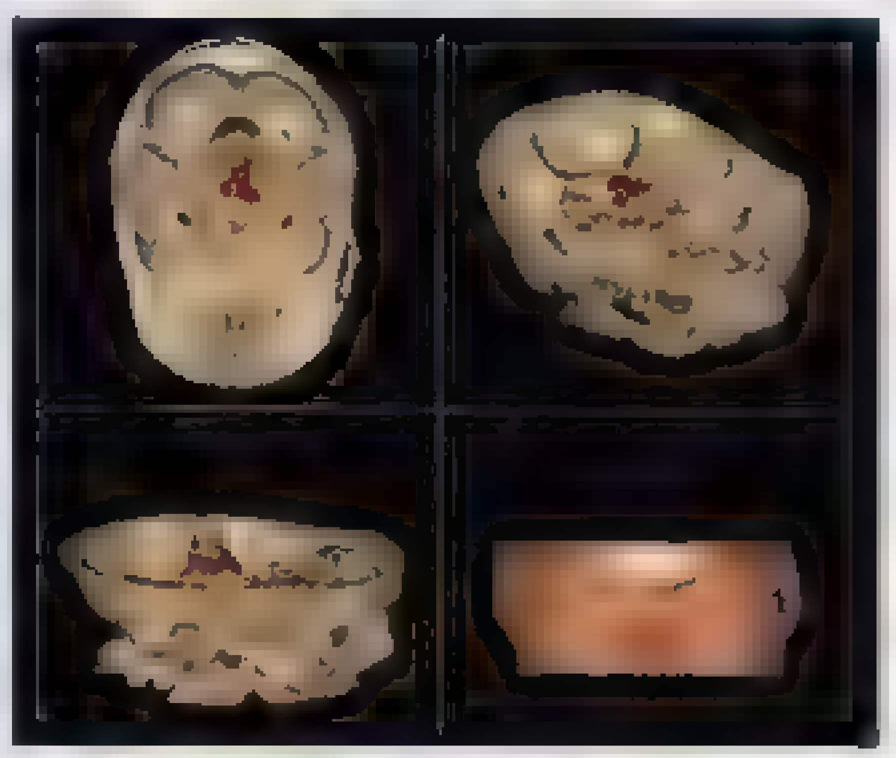
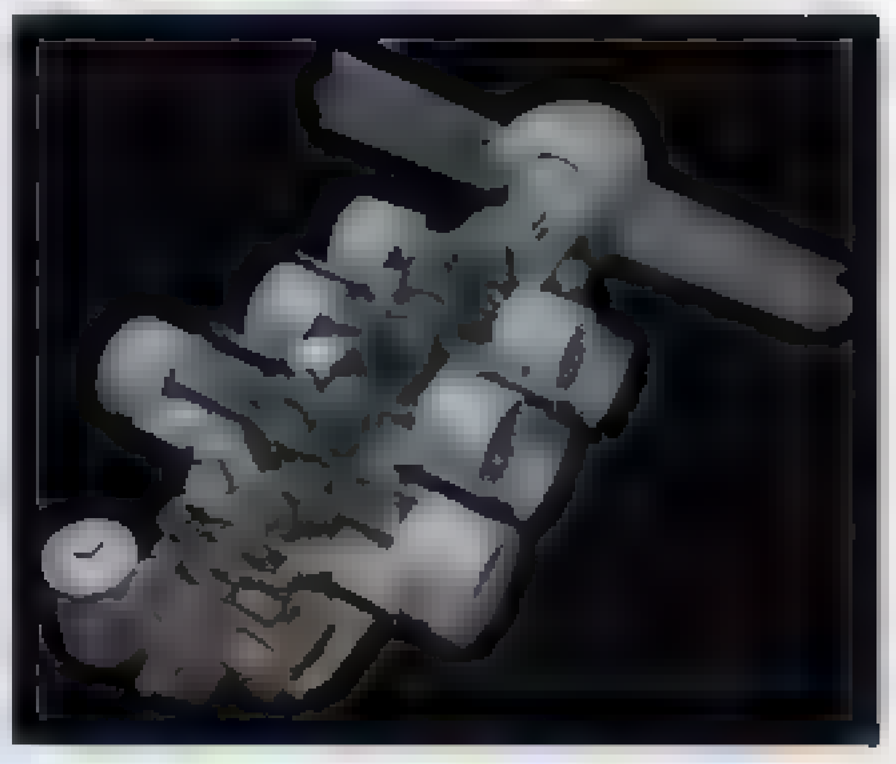
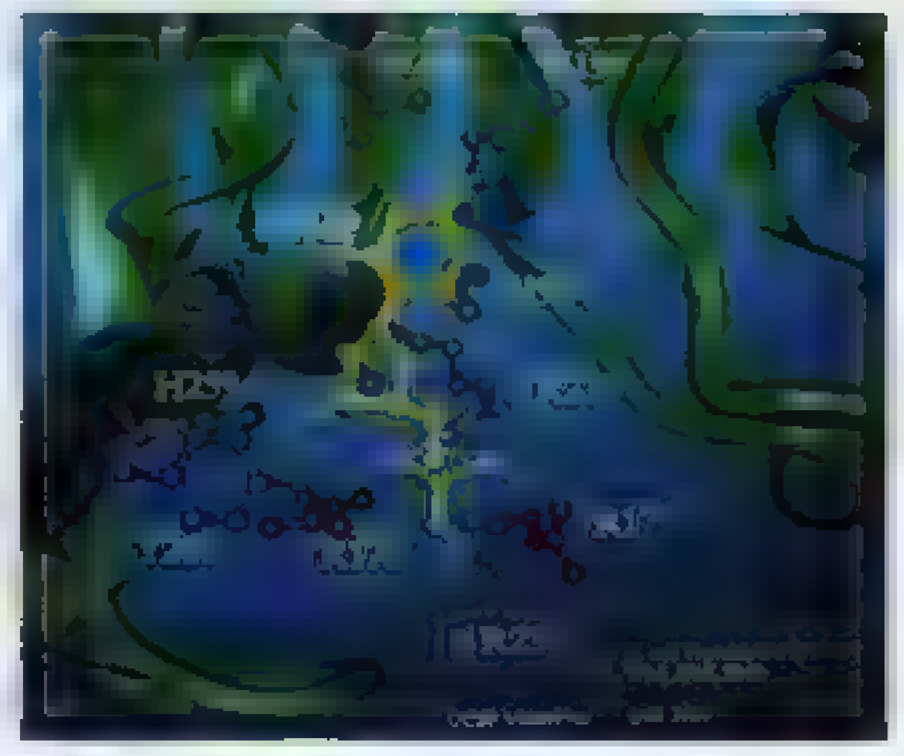


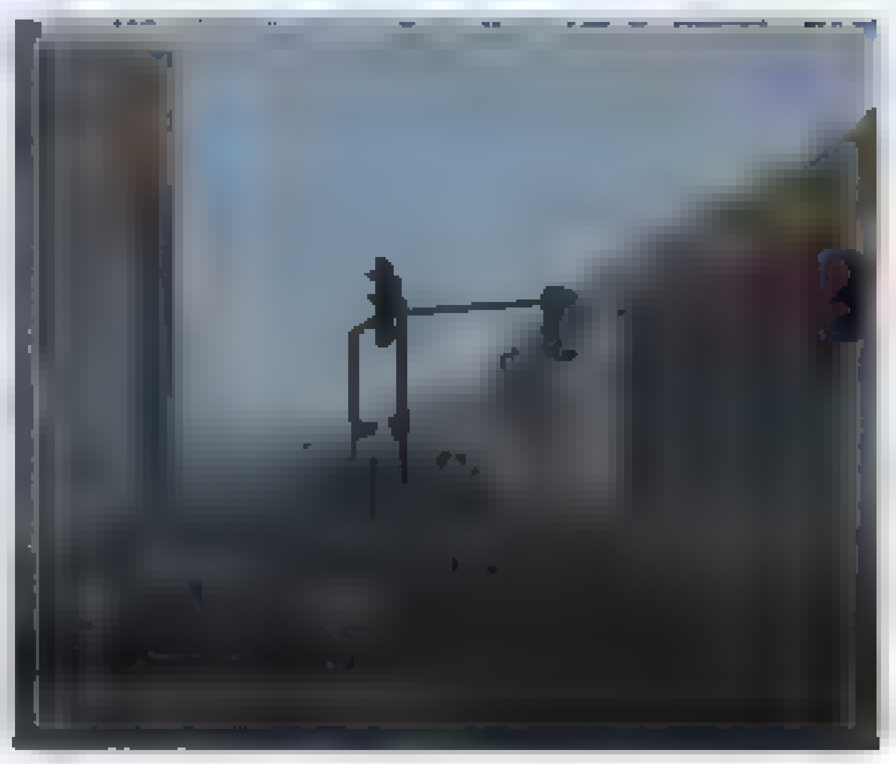
Image Processing and Medical Imaging: "A Calcified Anuerysm in the Skull of an Adult Male." An IRIS 4D/20 G workstation running MediCAD software was used to determine the extent and location of this anuerysm. Craniofacial surgeons were then able to perform successful surgery, saving the patient's life.



Mechanical CAE, CAD/CAM: "Engine/Accident Scene." Generated by Ted Malone at FTI/3D Magic in San Francisco, California using an IRIS 4D/70 GT workstation running Wavefront software



Computer-Aided Molecular Design: "A Close-up of the Active Site of the Enzyme Thymidylate Synthase." Produced in the Stroud Laboratory at the University of California, San Francisco on an IRIS 4D/80 GT workstation, using MidasPlus and Cartoon software. Ball and stick elements were used to represent key amino acid residues interacting with the substrate of Thymidylate Synthase, shown in yellow. A ribbon winds through the backbone atoms of the protein, revealing its helices and sheets.



Visual Simulation: "Waiting at a Stoplight for Traffic to Clear." Produced by Steven Fuhrman and Wes Hoffman of Merit Technology, Texas, on an IRIS 220 VGX workstation with SIMTOOL visual simulation software.

GIVE US YOUR BEST SHOT

AND WIN A CASH PRIZE

ANNOUNCING SILICON GRAPHICS' SECOND INTERNATIONAL VISUAL PROCESSING AWARDS

Deadline for Entries: April 30, 1991

How to Turn Your Graphics Into Gold Give Us Your Best Shot

Enter your hottest images in Silicon Graphics' Second International Visual Processing Awards, and you could win fame, glory and best of all, a cash prize.

Whether you work in animation, CAD/CAM, architecture or another field, your Silicon Graphics-based images should be part of our international celebration of creativity and excellence in visual processing.

It's your chance to show the world what you've known all along — that your work stacks up with the best in the business. Besides earning you a cash prize, your winning entry will be displayed at SIGGRAPH and featured in Silicon Graphics' IRIS Universe magazine. (How can you resist?)

Deadline for entries is April 30, 1991.

Pick A Category

No matter how you use visual processing, there's a contest category for you. Place your entry in any one of the following categories: *(Write category number on tape or transparency. Write category number on entry form where indicated.)*

1. Animation
2. Graphics Arts & Publishing
3. Architecture, Engineering, Construction
4. Computational Fluid Dynamics
5. Computer-Aided Molecular Design
6. Image Processing
7. Medical Imaging
8. Industrial Design (includes CAD)
9. Package Design
10. Computer-Aided Manufacturing
11. Computer-Aided Engineering
12. Earth Resource Management, Geosciences
13. Life Sciences
14. Visual Simulation
15. Scientific Visualization

The winner in each category will receive a cash prize. Category winners will be entered into the competition for the grand prize and runner-up awards.

Who is Eligible?

You are — provided you work for anybody except Silicon Graphics, its agencies or their affiliates. There's only one other requirement: Your images must have been created on a Silicon Graphics system.

How Will Entries Be Judged?

Your entries will be evaluated according to the following criteria:

- **Effectiveness** - Does the image effectively portray the information it is trying to reveal within its application?
- **Composition** - Does the image make effective use of the creative elements (color, line, shape and contrast)?
- **Originality & Creativity** - Is the image visually exciting, fresh, stimulating? Is the image a new approach to an idea?
- **Resolution & Quality** - Is the resolution (minimum 2-4K) and quality (anti-aliased, etc.) of the image suitable for publication?
- **Innovativeness of Technique** - Does the image challenge or stretch the boundaries set by the industry's current state of the art technology?

All entries must be created on a Silicon Graphics visual processing systems. In addition to the above criteria, entries must include a **detailed description** of the method, process or steps taken to achieve the image and why this method is innovative for its category to ensure proper judging. Entries may be re-classified into another category when necessary at the discretion of the judges.

Here's Your Best Bet to Win

To place your work in the best possible light, we suggest you submit your entry (or entries) as an RGB file on tape (2-4K resolution). That will enable us to produce your image with the highest possible resolution. Instructions for saving your screen image on tape are enclosed. In lieu of a tape file, you may enter color transparencies (35mm slides or 4"x 5" acetates - 2-4K resolution). We are also accepting **betacam** video entries under 2 minutes in total length. We will return betacam tapes once the judging has been completed.

Winners Will Be Announced

Winners will be notified by telephone within 60 days of the contest deadline. Prizes will be awarded within 45 days of notification.

Here's How to Enter.

Fill out the entry form and enclose it in an envelope with your entry. *This is important: Write the category that you are entering on the upper right-hand corner of the envelope.*

If you submit more than one entry on the same tape, please include a separate form with the file name of each entry. Entries submitted without an entry form or without a signature

on the entry form will also be disqualified.

Send as many entries as you like. If you submit entries for more than one category, please place them in *separate envelopes*. (Picky, picky!)

Saving Screen Images

IRIS workstations have a file format, supported by the library *–limage*, for storing digital images in the form of color *.rgb* files.

To save images in this format, you can use one of several methods. The simplest is to use the command **scrsave**. A command like:

scrsave dump.rgb

will save the contents of the entire screen in an IRIS image file. Or you can choose to save just a portion of the screen, using the command:

scrsave small.rgb 200 299 500 599

which will save a 100-by-100 square of pixels from the screen. To display the subimage you just saved, you need only type:

ipaste small.rgb

Another tool, **icut**, lets you interactively select and save a region of the screen. To use **icut**, type:

icut small.rgb

Next position the window on the screen, move your cursor into the **icut** window, and hold down the shift key. This will glue your input-focus to the **icut** window. With your shift key still depressed, move the cursor to one corner of the region you want to save and depress the left mouse button. Now, move to the opposite corner of the region you want to save and release the left mouse button and shift key. Wait for the **icut** window to disappear before trying to use the image file.

You can also save images from *inside* a graphics program by including the following function:

```
savewindow(name)
char *name;
{
char cmd[256];
int xorg, yorg;
int xsize, ysize;
int x2, y2;

getorgin (&xorg, &yorg);
getsize (&xsize, & ysize);
x2 = xorg+xsize-1;
y2 = yorg+ysize-1;
sprintf(cmd, "scrsave %s %d %d %d
   %d\n",name,xorg,x2,yorg,y2);
system(cmd);
}
```

A call like:

savewindow("save.rgb");

will save the contents of your current window into an image file.

I'M GIVING YOU MY BEST SHOT!

YES, I WANT TO AMAZE THE WORLD WITH MY ENTRY IN SILICON GRAPHICS' SECOND INTERNATIONAL VISUAL PROCESSING AWARDS

Detailed description of image and method and importance of technique used:

____

All entries must be created on a Silicon Graphics visual processing workstation. Deadline for entries is April 30, 1991.

YOUR NAME

TELEPHONE NUMBER

COMPANY

ADDRESS

CITY/STATE/ZIP

CATEGORY ENTERING (INDICATE BY NUMBER)

TAPE DENSITY FORMAT

FILENAME

SYSTEM & MODEL USED (MUST BE AN SGI SYSTEM)

SOFTWARE USED

The above information is true and correct to the best of my knowledge. I hereby transfer all intellectual property rights, including copyright to the image indicated above to Silicon Graphics, Inc. (SGI), and grant SGI a perpetual royalty free license to use such image for advertising, sales literature and any other purpose and in such medium as SGI, in its sole discretion, may determine This transfer of rights in no way prevents me from using these images myself, in any way I so choose. I understand that all materials sent to SGI as part of this contest will not be returned. I understand SGI is not responsible for any lost, damaged or stolen tapes or transparencies.

YOUR SIGNATURE DATE

Please include this form with your entry. Photocopied forms are okay. Please write category number on envelope.

MAIL TO: International Visual Processing Awards
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IMAGE ROAMING WITH THE HELP OF TILING AND MEMORY-MAPPED FILES

BY PRAMOD RUSTAGI

Today's desktop color scanners, such as the Sharp JX-600, are capable of scanning at resolutions of up to 600 dots per inch (dpi), producing image files of 100 kilobytes in size for a simple 8" X 11" picture. The Nikon LS-3500 scans 35mm film at a resolution of 4,000 pixels X 6,000 pixels, resulting in a 70 kilobyte file. A typical computer-generated image produced by a synthetic method like ray-tracing is of similar size.

In many applications, from color-publishing to medical imaging, it is necessary to roam about these images at full resolution on the computer screen to examine the detail of image features or flaws. By using the technique of image tiling, together with memory-mapping of the image file, we are able to view the image at fast rates, regardless of its file size. And because use of physical memory is minimal, it is possible to view many images simultaneously without system overload.

With tiling, a square patch of the image, say 64 X 64 pixels with 8-bit RGBA components, is kept in one disk block of 16 kilobytes. As we roam about the image in a window on the screen, only those tiles uncovered at the window border are retrieved from the disk. For a 512 X 512 window, we only need to read 8 tiles from the disk to repair the uncovered area when the image is to be moved downwards. The rest of the image is simply screen copied using the *lrectcopy()* routine from the Graphics Library™.

It's good to optimize the size of the tile to the size of the disk track of the drive on which the image resides. By matching the size of the tile to the characteristics of the disk, we maximize the physical IO performance to the drive for each tile read from the disk. Use */etc/prtvtoc* to print out information about the disk geometry.

Additional speed is gained by exploiting memory-mapping of the image file. Using the *mmap()* system call to set up memory-mapping between the process address space and the disk file, we no longer need to read the tile ourselves. We simply address the tile with an address pointer. The system does the read for us at the time it deems best, leveraging off of its virtual memory and file caching algorithms. Memory-mapping eliminates the expensive double copying of the data from the disk to a system file buffer and then to our address space, which is what happens with the old random-access technique of *lseek()* and *read()*. Additionally, *sproc()* can fire up a parallel process to anticipate the user's motion and pre-load nearby tiles into cpu memory.

Memory-mapping gives us one more useful tool — since we do not force valuable swap space to hold the image, we can view many images simultaneously, leaving the swap area free for more important activities.

The combination of tiling and memory-mapping allows real-time roaming of images even on Personal IRIS™ workstations configured with minimal amounts of real memory. On high end systems, greater speeds are achievable via advanced IO methods such as disk-striping, dual-channel disk controllers and organization of the image file in a tiled checkerboard fashion among the available disks. And, since only the subset of the image that is needed is read from the disk, performance is quite remarkable on NFS mounted file systems. The only caveat to fast image roaming is accessibility to large amounts of disk space on the network and access to the images themselves in electronic form.

Pramod Rustagi manages the product group of the Software Express software distribution program at Silicon Graphics. The scanned images are courtesy of GBA™. They were produced using the Nikon LS-3500 at various resolutions using GBA-Scanin™ software on the IRIS 4D/25 workstation.

```
/* assume the imagefile is organized as tiles of 64 x 64 pixels of 8-bit RGBA
   size of tile should match track size of particular disk type */

fd = open(imagefile, O RDONLY)

filesize = num tiles in file * size_of tile

/* memory map the beginning of the imagefile to a virtual memory address */

vaddr = mmap(0, filesize, PROT READ, MAP PRIVATE, fd, 0);

winopen( ).
singlebuffer();
gconfig().

/* queue gl devices */

while (1) {

  /* process gl queue & determine x,y movement of mouse, and resulting movement
     of screen image */

  /* determine which tiles need to be read */

  /* code is easier assuming window is not fragmented, ie  window is the
     topmost window */

  /* screen copy undamaged pixels to new location */

  readsource(SRC FRONT).
  lrectcopy( existing image on screen to x  y offsets ).

  for only the damaged tiles {

    /*calculate byte offset into the imagefile and add
      memory map offset */

    ptr = size of_tile * nth tile to be read
    ptr += vaddr;

    /*on certain IRIS models, use pixmode() to specify
      pixel strides in memory if pixels are not packed
      RGBA  However, striding pixels in memory will
      cause several disk blocks to be accessed for one
      tile. */

    /*paint the tile to the screen by simply passing the byte offset into memory
      mapped file */

    lrectwrite( , ptr);

  }

  /*to prevent physical memory from being exhausted, inform system of which
    tiles are not likely to be used in the near future */

  madvise ( ,  ,MADV DONTNEED);

}
```

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A new graphics board-set for personal computers promises to bring visual processing to an altogether new constituency, and makes it possible for PCs to out perform the Sun SPARCstation™

BY CYNTHIA M. MARSHALL

There is no question that workstations produce impressive three-dimensional (3D) graphics, but IBM personal computers (PCs) and compatibles — with an installed base of ninety-four million units — unquestioningly comprise the largest computing platform in use today. (By comparison, 726,000 workstations have been shipped since they came on the scene in 1981, according to industry-research firm Dataquest.) What options do the PC-bound have when it comes to producing 3D graphics?

Pushing out the Borders for PC Graphics

Until recently, PC users simply didn't have a lot of truly powerful options in graphics. For one thing, nearly all of the PC software that is currently available displays data and images in two dimensions. The graphics boards that facilitate 3D graphics on PCs have not encouraged the market, as they have generally been thought to have less-than-impressive performance at too high a price tag.

Now, Silicon Graphics' recent introduction of IRISVISION graphics boards enables users of Intel-based PCs to do the kind of sophisticated, 3D, visual processing that was once reserved for higher-priced systems, namely workstations.

The product, which is functionally equivalent in graphics (but not in processing speed) to the Personal IRIS™, will give PC users the ability to produce 3D models that can be rotated or swiveled on screen — for a list price as low as $3,500.

"The IRISVISION technology is bringing in a level of price versus performance that hasn't really existed before in PC graphics boards," says Joan-Carol Brigham, graphics analyst at International Data Corporation. "The closest existing technology is the i860-based boards, but their prices run 50 to 75 percent higher than Silicon Graphics' IRISVISION boards. Silicon Graphics' price point is very aggressive and they provide more power at a lower cost," says to Brigham.

Support for the IRISVISION boards within the PC industry has been widespread, with leaders from companies such as Microsoft, IBM, Compaq, and the Santa Cruz Operation publicly pronouncing their support. The only ones you'll hear bemoaning the IRISVISION technology are some workstation and PC graphics board manufacturers who have a high stake in the low-end market. They are likely to be more than a little nervous over the product's further blurring of the already fuzzy line between PCs and engineering workstations.

According to Silicon Graphics' President, Edward McCracken, "With our product, a PC will now out perform a Sun SPARCstation"

Software developers have also been enthusiastic about developing for IRISVISION. Within three months of the product's announcement, dozens of developers had expressed their commitment to the platform. This is particularly good news for professionals in fields such as mechanical engineering, architecture and space planning, 3D modeling, and creative graphics and animation. These are the areas where the bulk of product development for the platform is occurring.

CAD: The Make or Break Market

Whether the IRISVISION technology achieves market success depends to a large extent on its acceptance in the computer-aided design (CAD) market; more specifically, in order to win, Silicon Graphics initially needs to woo AutoCAD™ users to IRISVISION.

AutoCAD, which is produced by the Sausalito, California based company Autodesk, is the unquestioned leader in PC-based, MS-DOS, CAD software. The product enjoys a market share of more than 70 percent according to Daratech, Inc., a market research firm in Cambridge, Massachusetts. The next most popular program has only an 8 percent market share.

To facilitate the move to IRISVISION, Silicon Graphics has developed a software application called IRISVIEW™. IRISVIEW will allow IRISVISION board users to view and manipulate DXF files in real time. DXF is Autodesk's open standard for geometric data and the most widely used format for data transfer in the PC CAD market.

One of the primary advantages of the IRISVISION boards to AutoCAD users is speed. "Being able to view and manipulate AutoCAD models in real time is a big advantage of the IRISVISION technology," according to Walt Spevak, manager of Autodesk Device Interface (ADI) platform marketing. "Before IRISVISION, users could view and manipulate models, but not as quickly — certainly not in real time," he says.

Spevak views IRISVISION as something that stands to benefit Autodesk. "IRISVISION will allow us to offer a more productive solution to people who have more complicated projects that involve large databases and more complex geometry," he says. Spevak speculates that the boards will help Autodesk win major accounts in places such as government and large design firms.

Autodesk is one of several companies whose CAD software supports IRISVISION. Other developers include CADAM and CADKey.

Engine component, by Theodore Malone, FTI/3D Magic. Created on an IRIS 40/70GT workstation running Wavefront software.

How a PC with an IRISVISION Board-set Differs From a Personal IRIS

While the graphic capabilities of a PC with an IRISVISION board set are functionally equivalent to Silicon Graphics' Personal IRIS workstation, some major differences do exist between the two systems.

▶ Performance: The Personal IRIS delivers superior performance to a PC with an IRISVISION board set. This is true because on a Personal IRIS workstation, the graphics engine can be coupled tightly to the CPU — since they are both made by the same company, something that just isn't possible to do with a PC — because the components are manufactured by different companies.

An architectural model of a foyer, by Philip Dench Perth, Australia. Created on an IRIS workstation

▶ Operating system: The IRISVISION technology supports PCs running MS-DOS (with Phar Lap™), Santa Cruz Operation's Open Desktop, and Windows 3.0™. The Personal IRIS workstation runs IRIX™, a version of the UNIX® operating system.

▶ Migration path: The Personal IRIS workstation is more tightly integrated to Silicon Graphics' other products than a PC with an IRISVISION board set installed. While migration from a PC housing IRISVISION technology to a Silicon Graphics workstation isn't impossible, some application recoding is required, as the PC and IRIS platforms are not binary compatible. (Silicon Graphics workstations, however, are binary compatible across the product line.)

Visualization and Modeling: New Horizons for PC Users

Visualization and modeling software is a class of products that lets users such as architects and space planners create 3D models of environments and then explore them by 'walking through' or 'flying by' them in real time.

If this sounds light years ahead of the typical PC application, well — let's just say you won't mistake this software for a common word processor or database. That's exactly what has Booth Kalmbach, president of Virtus Corporation, so revved up about developing for IRISVISION.

"One of the exciting things Silicon Graphics is doing is laying the base for applications that are different from what has come before," says Kalmbach. His company's product, Virtus WalkThrough™, lets spatial design professionals — a group which includes architects, engineers, product designers, set designers, and facility planners, among others — quickly construct, then immediately experience a building, room, or other space. The product is used primarily in the creative phase of a project and data can later be exported to programs like AutoCAD for further development.

Virtus WalkThrough is already available on the Apple Macintosh™ computer, but Virtus' director of research and development, David Smith, is particularly excited about the IRISVISION board set. "IRISVISION uniquely provides the user with real-time feedback; the Macintosh version has similar functionality, but isn't as fast," says Smith.

Virtus is one of several companies that will be producing visualization software for the platform. Other developers include Bechtel Software, Dynaware, New Image Industries, Stephen Dedalus, and Gimeor.

Graphics and Animation: More Sophisticated, Easier to Use, for More Users

In graphics and animation, Silicon Graphics expects to compete successfully with the higher-end models of the Apple Macintosh computer. Regardless of how well the company competes against Apple, the IRISVISION technology is unrivaled in the PC market, where a significant portion of the huge installed base either doesn't want to or is unable to abandon the platform.

"The sheer size of the PC market, the momentum of the user interface changes in the DOS environment, and customer demand," are the reasons why Bill Woodward says his company, Paracomp, is headed into full-scale product development for IRISVISION. Woodward is the president of the San Francisco based company whose product line includes the award-winning

Engine component, by Theodore Malone, FTI/3D Magic. Created on an IRIS 4D/70GT workstation running Wavefront software.

Swivel 3D™, a 3D drawing and modeling program; ModelShop™, a 3D architecture and design program; and FilmMaker™, an animation and presentation program.

Until now, Paracomp has been exclusively a Macintosh software developer. But Woodward says that many of his company's existing clients have asked for PC versions of the Macintosh software.

"Many are already accustomed to a PC, perhaps because they already have one on their desk or their company has standardized on it. With the PC's user interface getting closer in ease of use to the Macintosh and with Silicon Graphics' Graphics Library™, IRISVISION may be a more cost-effective way for these users to go," he says.

Woodward is particularly excited about working with the Graphics Library (GL™). "Silicon Graphics is the premiere company for 3D graphics and their graphics library is really good. You can make calls to it when writing code and it's almost system-like software for 3D."

His enthusiasm over the GL is not insignificant. From an end-user's point of view, the GL's power enables applications to run considerably faster than they otherwise could.

From a business perspective, the better Silicon Graphics' development tools are considered to be, the more developers will be attracted to them. This means that a greater number of applications stand to be developed for the platform — another element that is crucial to long-term success — and also for the company's entire product line. (The GL is common across the company's products; many consider it an emerging industry standard.)

The product Paracomp is developing for the IRISVISION platform — a graphics application — is scheduled to be released during the second half of 1991.

Other companies developing graphics and animation software for IRISVISION include SOFTIMAGE and Time Arts.

Opening up Distribution

Unlike Silicon Graphics' other products, which are sold by the company's own sales force, the IRISVISION boards are sold by independent resellers and dealers, who receive product directly from the company.

Working directly with resellers, rather than using established distribution channels allows Silicon Graphics' staffers to work more closely with and to train those who will be making actual sales and providing the bulk of the post-sales support for the product.

From a reseller's perspective, the company's approach helps to protect ever-shrinking profit margins, too. "Silicon Graphics' approach is terrific," says Brian Jenkins, owner of Computer Drafting Solutions, a systems integrator. "They have a select few dealers — about forty in the West, I think — and this small number will help protect our margins. Having a small number of resellers enables each dealer to sell as close to the retail price as possible," he says.

Supplying resellers directly with the product also allows smaller organizations to deal in technology that they might otherwise have been locked out of selling. "In the past, vendors either sold directly or via distributors. Vendors very rarely sold to value-added resellers (VARs) or chains because the vendors' products were seen as commodities, not as a solution," according to Reza Wajih, owner of SoftCAD, a VAR in Houston, Texas. "People like me couldn't go to distributors because their volumes are usually too high," he added.

Moving sophisticated graphics into the reseller channel stands to benefit Silicon Graphics, too, inasmuch as the company can carve out recognition and a loyal customer base ahead of other companies.

A large installed base of PCs, a low price, the right visual processing applications, and broad distribution — Silicon Graphics now has all the ingredients necessary to put 3D graphics of unrivaled quality in every office and two IRISVISION boards in every PC.

Cynthia Marshall is a freelance writer in Palo Alto, California.

For more information about IRISVISION board-sets for your PC call the IRISVISION hotline at 1-800-338-6272.

Technical Specifications

IRISVISION supports eight- and 24-bit color on MicroChannel and AT personal computers running applications supporting the IRIS Graphics Library MS-DOS (with Phar Lap), SCO Open Desktop, or Windows 3.0. VGA passthrough enables one to continue using PC-based productivity applications. The product supports 1280 x 1024 or 1024 x 768 resolution monitors. IRISVISION is bundled with a 24-bit z-buffer. The two-board set uses Silicon Graphics' IRIS Graphics Library software interface, which facilitates the development of high-performance visual processing applications.

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Resurrecting A 17th Century Artist

VISUAL PROCESSING COMES TO THE RESCUE

OF A CEILING FRIEZE PAINTED BY ORAZIO GENTILESCHI

OVER 350 YEARS AGO.

BY CRISPIN LITTLEHALES

On May 1, 1990, the world's first computer-aided restoration of a masterpiece painting was unveiled at the opening of the newly renovated Queen's House at Greenwich, England. Looking up from forty feet below, it is impossible to detect the copy from the original.

This extraordinary reproduction was done by Graphic Palette, a Camden-based reproduction studio that has configured its own multi-component transparency retouching system to produce high resolution images of superior quality. In six weeks' time, Graphic Palette was able to recreate the magnificent 17th century ceiling friezes created by the Italian painter, Orazio Gentileschi, simulating the artist's own brush strokes.

REMOVAL TO MARLBOROUGH HOUSE CAUSES IRREPARABLE DAMAGE

The original work consisted of nine ceiling paintings depicting an allegorical representation of *Peace Surrounded by the Muses and the Liberal Arts*. Completed by Gentileschi in 1631, they were constructed to fit neatly on the ceiling in the Great Hall of the House, which was designed for Anne of Denmark by Indigo Jones. There they remained for nearly seven decades, until Sarah, Duchess of Marlborough, purchased the panels and had them moved to her own residence—Marlborough House. There, the paintings sustained considerable damage.

The Duchess had Gentileschi's masterpiece cut and trimmed to fit the configuration of the ceiling at Marlborough House. The circular center panel lost nearly three feet in diameter, while another panel was mutilated by a large chimney breast pushed through its center. The east and west side panels were significantly shortened and those on the north and south were reduced in width and slightly extended in height. The four corner roundels were, in fact, the only pieces that fit perfectly into their new home. Although some cleaning and repairs had been made by Britian's Ministry of Works in 1959-60, the panels were cracked and scratched in places, with much of the color faded.

REVITALIZATION OF THE QUEEN'S HOUSE

In 1984, the National Maritime Museum, which had acquired the Queen's House as part of its gallery space in 1936, closed down the premises to perform a £5 million renovation. The museum hired skilled craftsmen to replicate the furnishings and wall hangings as well as some of the interior carvings. The restoration of the Gentileschi friezes, however, involved an entirely new set of difficulties.

The museum's design manager, Lionel Willis, considered having copy artists repaint the images. This traditional approach would have cost a great deal of money and required months, if not years, to complete. Moreover, the copy artists would not have been able to replicate the subtleties of Gentileschi's painterly style — a point of major importance to Willis and the museum.

Willis knew of a company in Lancashire — Scanachrome — that had invented a printing process capable of producing massive enlargements of photographic transparencies. Willis was also familiar with computer imaging technology and decided to explore a combination of the two as a possible means for restoration.

A DIGITAL SOLUTION

After considerable discussion and research, Willis located Graphic Palette. The Queen's House project was not a typical job for the firm, which makes most of its revenues from providing pre-press art in the form of computer-generated color transparencies for use in print advertising. Nonetheless, Graphic Palette had both the systems and the expertise to handle the assignment.

Established in 1985 in Manchester, England, by Brian Wilcock and John Parr, Graphic Palette now has offices in London and employs 30 people. Two years ago, the company put its own color reproduction and transparency retouching system together. The powerful configuration integrates two Silicon Graphics 4D/80 GT workstations and two 4D/25 Turbo systems, a Crosfield scanner to feed image data to a Scitex typesetting unit, Kodak's light valve technology (LVT) film recorder to output high-resolution transparencies, and a paintbox application package from Barco Industries of Belgium, called the Barco Graphics Creator™. The system creates very large data files — 110MB and more — and Graphic Palette has 5 Gb of disk storage to accommodate them.

STAYING TRUE TO THE ARTIST

Producing an authentic looking, uncut version of Gentileschi's panels presented both technical and creative challenges. On the technical side, Graphic Palette had to invent procedures and techniques while their work was in progress, since no precedent for this kind of work existed. From a creative standpoint, Graphic Palette had been asked to replicate the artist's own hand and to use Gentileschi's brush strokes taken from the actual painting. Graphic Palette

planned the job carefully, working closely with Michael Helston, curator of later Italian pictures at the National Gallery, who served as a consultant on the project. Helston provided vital source material for filling in the missing pieces.

After photographs had been taken of the paintings on the ceiling at Marlborough House, Graphic Palette developed pencil sketches of the whole design so that Helston could provide advice and guidance in advance of doing work on the system. Since no pictures or records of the original ceiling exist, Helston had to guess how to fill in the gaps in a fashion that made visual sense.

Once Helston had provided input and approved sketches, the transparencies were scanned into the Concept Design system and converted into computer images. Most of the system work was then performed by Gandee Vassan, who had joined Graphic Palette only six months earlier. With a degree in fine arts from Kings College and a year of studying computer graphics at Coventry Polytechnic, Vassan said he drew mostly on his background as an artist to get the job done.

By applying the Barco Creator software tools to painterly functions, Vassan was able to approach the project as he would a painting. Working with a pressure sensitive light pen and an electronic tablet, he handled the image manipulation and retouching as transparently as possible to maintain the look and feel of the original painting.

MAKING THE PIECES WHOLE AGAIN

Each of the nine panels required varying degrees of restoration. All four rectangular side paintings were missing significant sections at the top, bottom or sides. For the most part, the non-existent areas consisted of sky and clouds. To replace these areas, Vassan used the Creator's cut and paste function. He sectioned off a specific block of sky from another area on the painting, used the copy command and pasted down the cloned section to fill in the blank areas. Then, he used the copy brush function to replicate Gentileschi's brush stroke style and make the build up of pixels look sufficiently different from the original piece of sky. Because the electronic pen and tablet are pressure sensitive, the copy brushing function can be applied in varying densities using a variety of brush types, including: pastel brush, hard brush, air brush, rectangular brush, and circle brush.

The rectangular north and south panels that feature Euterpe (muse of music) and Calliope (muse of epic poetry) had been reduced in width. To bring these back to size, Vassan pried the paintings apart at the center to minimize the amount of filling-in on either side. First, he outlined the areas to be separated and cut the image down the middle using line art and a mask mode to protect the area he didn't want to touch. He then took the area he wanted to alter into memory and moved it the specified distance.

The circular center panel also required prying apart and filling in. In addition, it had numerous joins and cracks as well as a detectable gradient in coloring. Vassan again used copy brushing to eradicate the blemishes and corrected the coloring by creating a graded mask with the mask mode.

On the rectangular east panel, Vassan dealt with a missing foot on Terpsichore, the muse of choral dancing. Here, Vassan cloned the foot of Calliope, using cutting and pasting as well as drawing functions to reshape Calliope's heavier, more masculine foot into a sufficiently feminine form. Vassan pasted down the foot and used the drawing and copy brushing functions to repaint some of the muse's red robes and blend the new foot successfully into the image.

Several other objects had to be recreated as well. Based on input from Michael Helston, Vassan used both his drawing skills and copy brushing to replace the top portion of a celestial globe, the staff in the rectangular west panel, and the top of the lute in the facing east panel. In addition, Vassan used a facility called mirror to reconstruct the crown hanging from the staff.

Beyond the major restoration work, Vassan used copy brushing to eliminate the general effects of aging in the four roundels and to extract bullet holes from one of the panels. He also used it to disguise shiny areas caused by lighting problems when the panels were photographed. To boost colors and alter tones, Vassan used the Creator's color correction function. The entire project was completed without any programming.

Once the reconstruction had been completed and approved by the museum, Graphic Palette used the Kodak LVT system to produce 14"x11" high resolution transparencies. These were sent directly to Scanachrome for final output on vinyl-coated polyester, using an ink jet printer linked to a photoscanner. Each panel was printed in one piece, with the exception of the circular center painting. That was done in four sections mountedon to a glass fiber board before being affixed to the ceiling.

IS IT REAL, OR IS IT GRAPHIC PALETTE?

When Lionel Willis came to Graphic Palette with the Queen's House assignment, he stressed that the museum was not trying to reproduce the ceiling exactly as it was, but, rather, to recreate the effect of the Gentileschi masterpiece for the visitors to the Great Hall. Graphic Palette far exceeded the goal. Thanks to Helston's guidance, Vassan's skill and artistry, and the sophistication of Silicon Graphic's hardware and Barco's software, tourists and art connoisseurs can now feast their eyes on a near perfect replica of a masterpiece that was nearly ruined two hundred years ago.

Crispin Littlehales is a freelance writer in San Francisco, California.

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  - ▫ Automotive
  - ▫ Computing
  - ▫ Petroleum
  - ▫ Textiles
  - ▫ Other
- ☐ **Government**
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  - ▫ Dept. of Energy
  - ▫ Dept. of Trans.
  - ▫ Health
  - ▫ NASA
  - ▫ Other
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  - ▫ Engineering
- ☐ **Research**
  - ▫ Chemistry
  - ▫ Geosciences
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  - ▫ Pharmaceutical
  - ▫ Other Life Sciences
- ☐ **Computer Sftwre. Dev.**
- ☐ **Education**
- ☐ **Other** ________

My application interests are:

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- ☐ Artifical Intelligence
- ☐ CAE
- ☐ Finite Element Analysis
- ☐ Fluid Dynamics
- ☐ Image Processing
- ☐ Industrial Design
- ☐ Man/Machine Interface
- ☐ Mechanical CAD/CAM
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- ☐ Molecular Modeling
- ☐ Pre-press
- ☐ Visual Simulation
- ☐ Robotics
- ☐ Scientific Visualization
- ☐ Other (Specify) ________

My IRIS workstation is a:

- ☐ Power Series
- ☐ 4D/GT
- ☐ 4D/G
- ☐ 1000/2000/3000
- ☐ Personal IRIS
- ☐ ________

The number of IRIS workstations at my site is:

- ☐ 1–5
- ☐ 6–10
- ☐ 11–20
- ☐ 21–50
- ☐ More than 50
- ☐ None

Software Utilized:

- ☐ Public Domain Software *(please specify)*
- ☐ Custom Software
- ☐ Third-Party Software

____

My job function is:

- ☐ Corporate Mgt
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- ☐ Consulting
- ☐ Engineering Mgt
- ☐ Engineering Staff
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My organization's total sales volume or budget:

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I purchase or influence the purchase of the following graphics and imaging products:

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- ☐ Networking products
- ☐ Boards/controllers/subsystems
- ☐ Monitors/Displays
- ☐ Scanning/image capture devices
- ☐ Plotters
- ☐ Storage or memory devices
- ☐ Color Printers
- ☐ Laser Printers
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- ☐ Presentation systems
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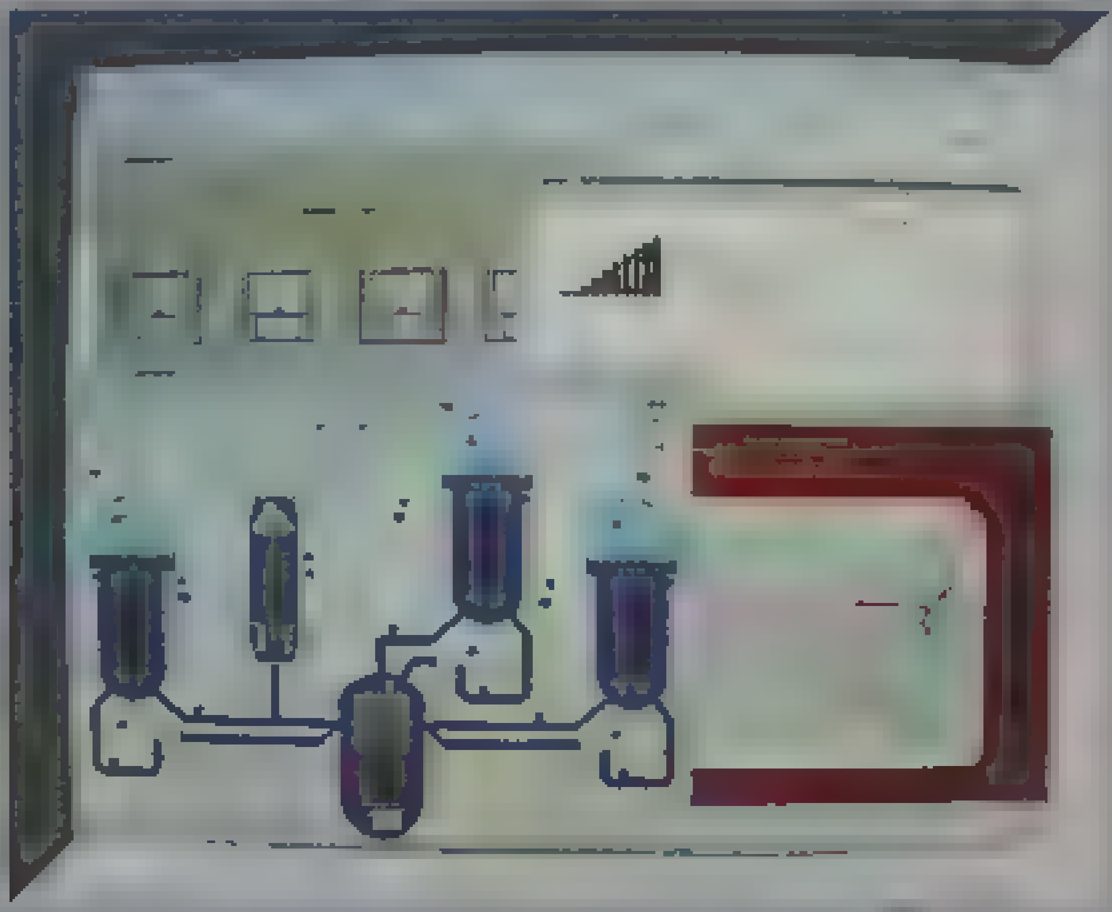

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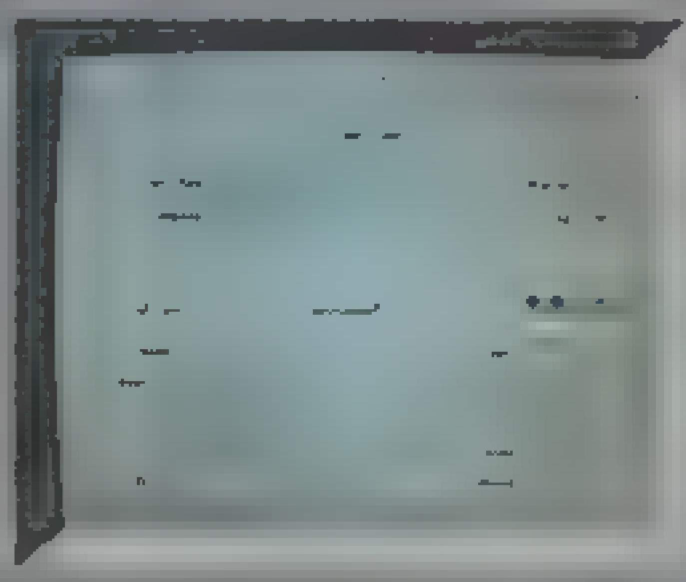
With the rise of graphics workstations has come a demand for tools that speed the development of graphics screens for applications. A bewildering array of tools has appeared to aid developers with X Windows and the primary GUI styles: MOTIF, Open Look and DECwindows. Many of these tools are WYSIWYG editors limited to the creation of standard widgets such as menus, scroll boxes, sliders and buttons. Standard widgets, however, are not enough for application visualization. Inevitably, the need arises for custom screen objects (graphs, maps, icons and other pictures) which are beyond such tools, and which are too time-consuming to create with Xlib. Developers also need a way to visualize changing data in real time.



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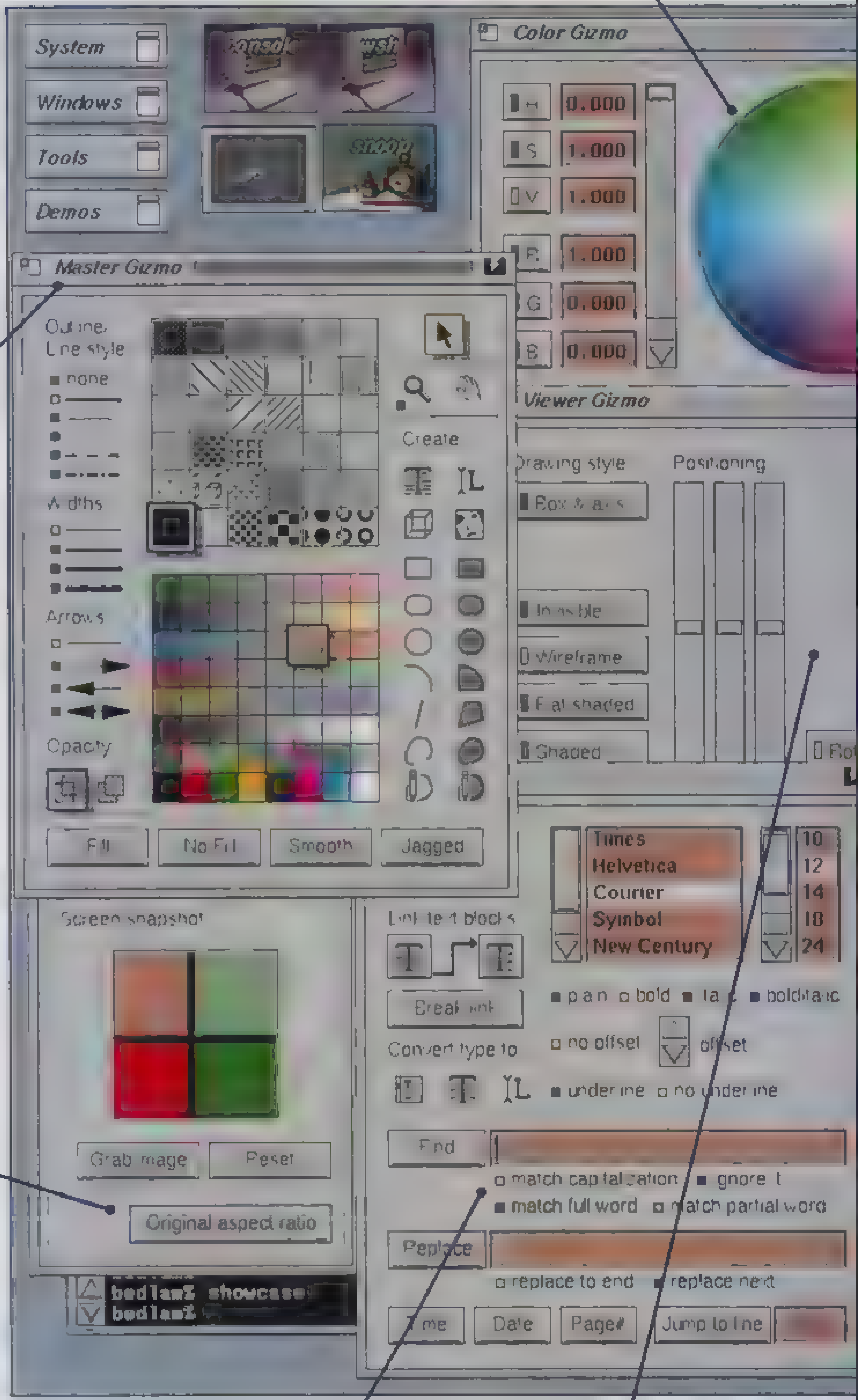
IRIS SHOWCASE™

This screen showing the interface for IRIS Showcase is considerably more cluttered than a screen would be under normal working conditions. For the purposes of this illustration we've packed-in as many Gizmos as possible in order to display the diversity and usefulness of the software.

D The Color Wheel allows one to change the colors in the Master Gizmo's color palette (see **A**) using the wheel, the slider, or by typing in RGB or HSV components. The Color Wheel Gizmo also provides a mechanism for taking existing colors in the Showcase window and inserting them into the color palette.



A This is the Master Gizmo, the control panel used for most drawing operations. Master Gizmo contains color and texture palettes, buttons to create text, images, 3D viewers, rectangles, circles, general polygons, spline curves, freehand drawings (the large star at lower right was drawn freehand, as was the rounded-triangular form below it), and numerous other options.

E Showcase displays any images in Silicon Graphics Image file format. Additionally, the Image Gizmo allows one to cut images from the screen and insert them into a Showcase file. In this illustration the Image Gizmo shows a magnified portion of the lower left corner of the Master Gizmo's color palette that has been cut and pasted into Showcase's Main Window (for more about this feature see **I**)

B This is the Text Control Gizmo used for changing type fonts and sizes. Text Control also contains buttons for underlining, super- and sub-scripts, and linkage among blocks of text which makes it possible for the text to flow from one column to the next, from page to page, or around illustrations. This gizmo controls textual search and replace, and line-based navigation.

F The Viewer Gizmo controls the orientation and display characteristics of 3D models in the viewers.

BY THOMAS DAVIS

Have you ever wished you could easily create an overhead projection transparency of a 3D image for use during a meeting or presentation? Have you wanted to send a UNIX mail message that included drawings, images, and 3D models in addition to the usual text? Now, thanks to four of Silicon Graphics' software engineers (two of whom were founders of the company), it's possible to do so with IRIS Showcase, a new software product that enhances the functionality of IRIS workstations.

IRIS Showcase is a drawing and presentation tool that allows users to include 3D models and raster images in documents, along with the usual 2D images and text. Documents generated

(continued on page 30)

C The Text Ruler is used for adjusting paragraph styles and justification, margins, tab settings, and inter-line and inter-paragraph leading.

X This is the main IRIS Showcase window. At its top is a row of pull-down menus, below the menu strip is the drawing area containing text, 2D and 3D graphics and images. Complete on-line help is accessed via the main window's HELP menu.

J Two 3D models, the Adirondack Chair and the Space Worm, are displayed in this Showcase document. The orientation of these models can be controlled with either a track-ball interface or the 3D Viewer Gizmo.

G Showcase supports standard 2D graphics, such as rectangles, circles, and arcs, as well as general filled and unfilled NURBS splines. Showcase also allows one to shade arbitrary polygons or spline curves.

H While it is not a word processor, Showcase has impressive text editing and display capabilities (see **B** and **C**). The software has an interface to the UNIX spelling checker (not shown), and a keyboard gizmo (also not displayed in this illustration) which allows the typing of special characters, accents, and mathematical symbols. In addition, Showcase can be invoked as an ASCII text-only cut and paste editor utilizing the same interface as that used for drawing or creating presentations.

I These two images were cut directly from the screen. Showcase makes it possible to stretch or shrink images (the piece cut from the color palette on the Master Gizmo has been stretched. The image below it with the clock and icons was cut from the WorkSpace at the top left of the screen. It has been slightly reduced in size). This feature can be used to import images into Showcase from other IRIS applications, making it easier to produce presentations which contain images or text from other work you're doing on the system.

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with Showcase can be viewed on-line, displayed as an automatic slide show, printed, or encoded as ASCII and distributed via electronic mail. The text capabilities are powerful enough for short documents and slides, but do not constitute a word processor. Users within Silicon Graphics as well as those at several beta sites have found Showcase to be a useful, valuable tool. It is now bundled with each new IRIS workstation, and is available to current users of IRIS systems at a cost of $100.

No, Silicon Graphics is not getting into the software business. The code was written to *show* what can be done with our hardware by creating a useful tool rather than a demonstration program. The source code is tuned to run on Silicon Graphics systems and will be available to developers for a nominal fee, allowing them to incorporate the techniques or actual code segments into their own products.

IRIS Showcase was written entirely in C and makes calls only on the IRIS Graphics Library, the image library, and UNIX. There are no window manager dependencies nor calls on unreleased or internal Silicon Graphics libraries. Although the code is not organized as a tool kit, it is cleanly structured and numerous interesting parts can be extracted with ease.

The user interface is organized around "gizmos" — independent programs running in their own window that communicate with the main program via UNIX sockets. For example, the File Browsing Gizmo allows a user to navigate the UNIX file system and, when the "Accept" button is pressed, the path name is sent to the main Showcase application over the socket. The File Browser Gizmo can be added to a developer's application simply by adding the code used to start the gizmo, setting up the socket, and reading the results. Other Showcase gizmos that may be useful to developers include the color wheel, a dialogue box, the Keyboard Gizmo, which allows one to type special characters, accents, and mathematical figures, and a spelling checker that provides a graphical interface to the UNIX spelling checker.

Other useful code in the main program includes segments that subdivide polygons, manipulate 3D models, allow one to manipulate color in a uniform fashion on all Silicon Graphics hardware, rapidly display text in mixed fonts, styles, and colors, and a variety of other useful functions. The main program also provides an example of how to structure a complex program in a way that is optimized for Silicon Graphics computer systems.

IRIS Showcase will continue to grow and take advantage of new software and hardware features as they become available. As the tool evolves, future enhancements will be made available to the development community. In this way Silicon Graphics will provide developers sample code that takes optimal advantage of the opportunities afforded by visual processing technology and that will ultimately benefit all users.

Thomas Davis is a Principal Scientist in the Engineering Group of the Entry Systems Division at Silicon Graphics.

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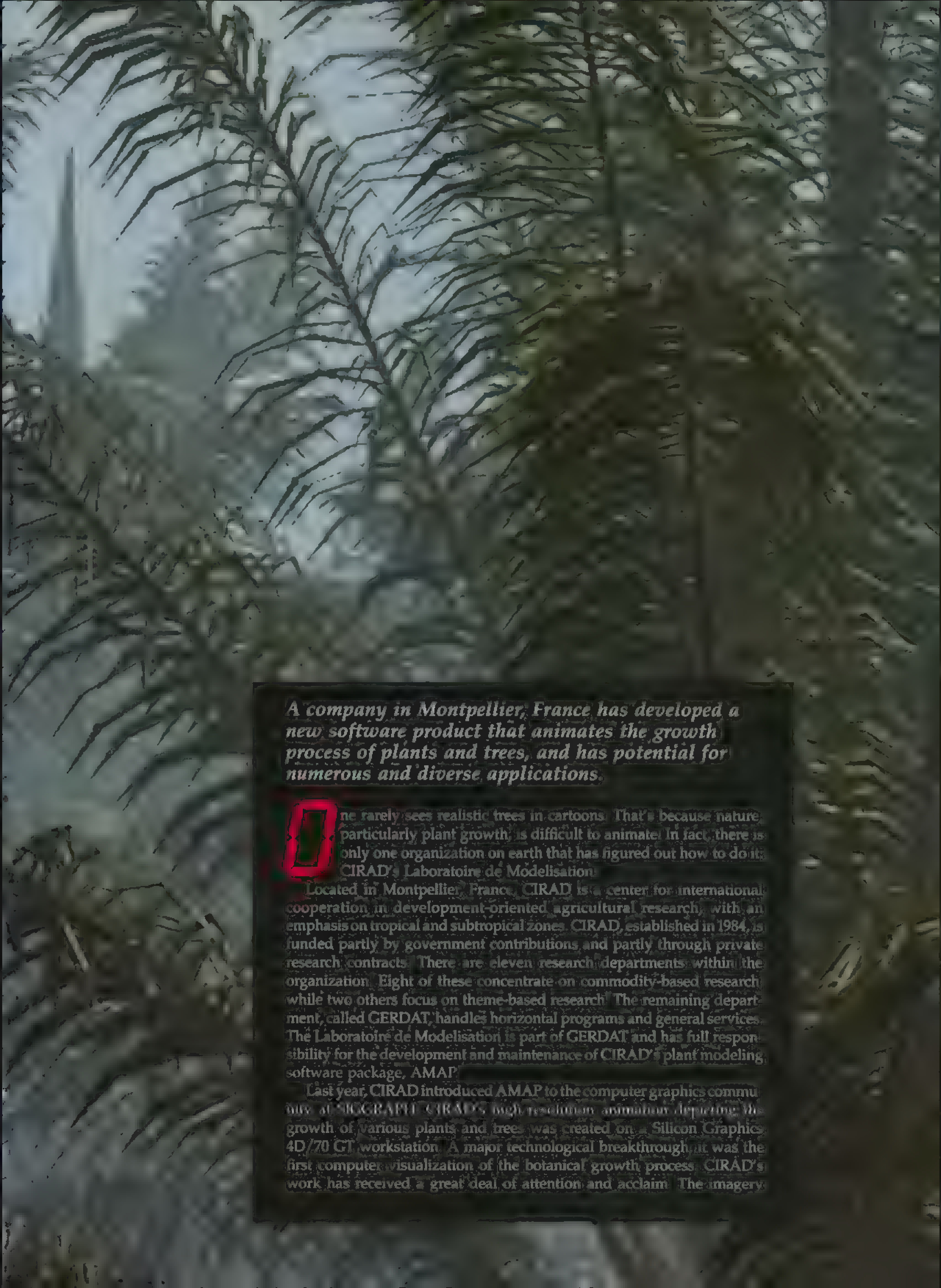
THE DIGITAL LANDSCAPE

BY PIERRE DINOUARD AND PATRICK RENVOISE

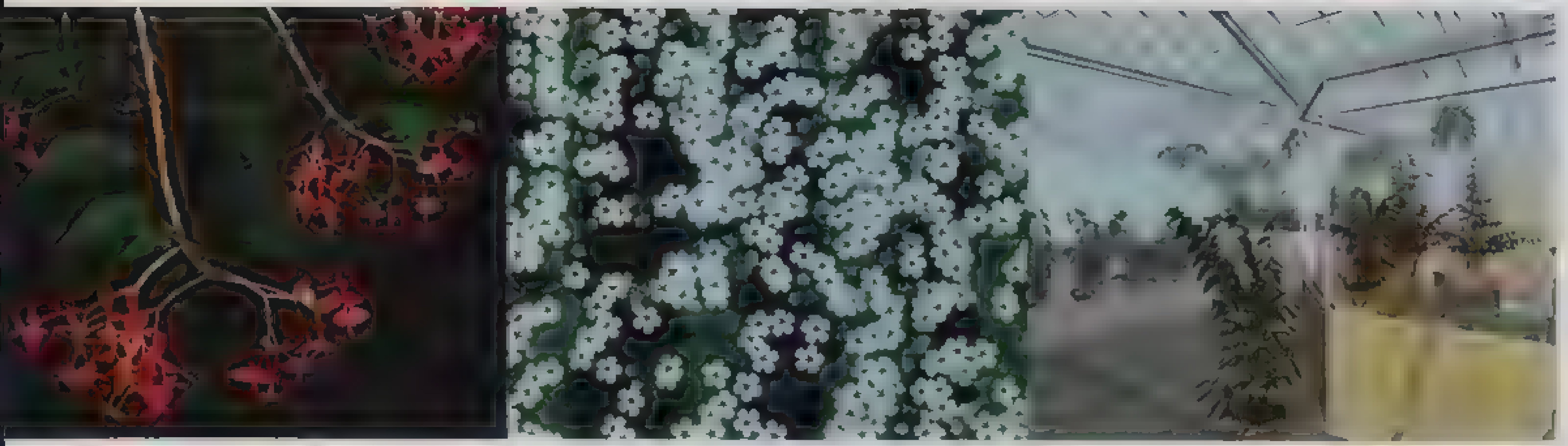


A company in Montpellier, France has developed a new software product that animates the growth process of plants and trees, and has potential for numerous and diverse applications.

One rarely sees realistic trees in cartoons. That's because nature, particularly plant growth, is difficult to animate. In fact, there is only one organization on earth that has figured out how to do it: CIRAD's Laboratoire de Modelisation.

Located in Montpellier, France, CIRAD is a center for international cooperation in development-oriented agricultural research, with an emphasis on tropical and subtropical zones. CIRAD, established in 1984, is funded partly by government contributions and partly through private research contracts. There are eleven research departments within the organization. Eight of these concentrate on commodity-based research while two others focus on theme-based research. The remaining department, called GERDAT, handles horizontal programs and general services. The Laboratoire de Modelisation is part of GERDAT and has full responsibility for the development and maintenance of CIRAD's plant modeling software package, AMAP.

Last year, CIRAD introduced AMAP to the computer graphics community at SIGGRAPH. CIRAD's high-resolution animation depicting the growth of various plants and trees was created on a Silicon Graphics 4D/70 GT workstation. A major technological breakthrough, it was the first computer visualization of the botanical growth process. CIRAD's work has received a great deal of attention and acclaim. The imagery



presented in the Laboratoire's 3D film, *Palmeraie sous la brume*, received the Grand prix de l'image scientifique at the PARIS CITE 90 creative technology exhibition. More recently, CIRAD was one of the winners in Silicon Graphics' Visual Processing Awards with its rendering of the "Growth Simulation of a Begonia Elithe" (see page 9).

AMAP is based on a revolutionary theory of plant growth modeling that was invented by Phillipe De Reffye, director of the Laboratoire. De Reffye spent more than a decade in Africa observing plant growth and formulating mathematical algorithms to describe the growth process, including the random growth of leaves and branches. Upon returning to France in 1983, De Reffye began working with a student of computer graphics to build software that provided simplified graphic renditions of the biological plant growth parameters. These very basic images were output on a plotter.

In 1987, the Laboratoire de Modelisation installed its first Silicon Graphics system (a series 3000). This enabled De Reffye and others to visualize the results of the statistical processes that had been applied to measuring plant growth and to begin development of the AMAP program. There are currently two Silicon Graphics 4D/20 and two 4D/25 systems as well as one 4D/70GT workstation in use at the Laboratoire. The AMAP software now supports applications that go far beyond the original agronomy-oriented research. Moreover, the resulting graphics can be output directly to film.

Research and development of AMAP involved a number of different scientific disciplines; agronomy, botany, mathematics and computer graphics. Specialists from each of these areas worked closely to develop models for understanding the biological phenomena that controls plant growth and population dynamics.

The software has two main components; the AMAP Engine and Engine HQ and the AMAP LandMaker. The Engine serves as a plant growth simulator with 3D output in the form of a skeleton tree or plant figure. It receives information regarding the biological plant growth parameters from the Growth Database. The Terrain module generates terrain information with isovalue curves and filled surfaces. An Access module provides a CAD-CAM interface and the Figures module has a quick 3D modeler for geometrical patterns such as leaves and fruit.

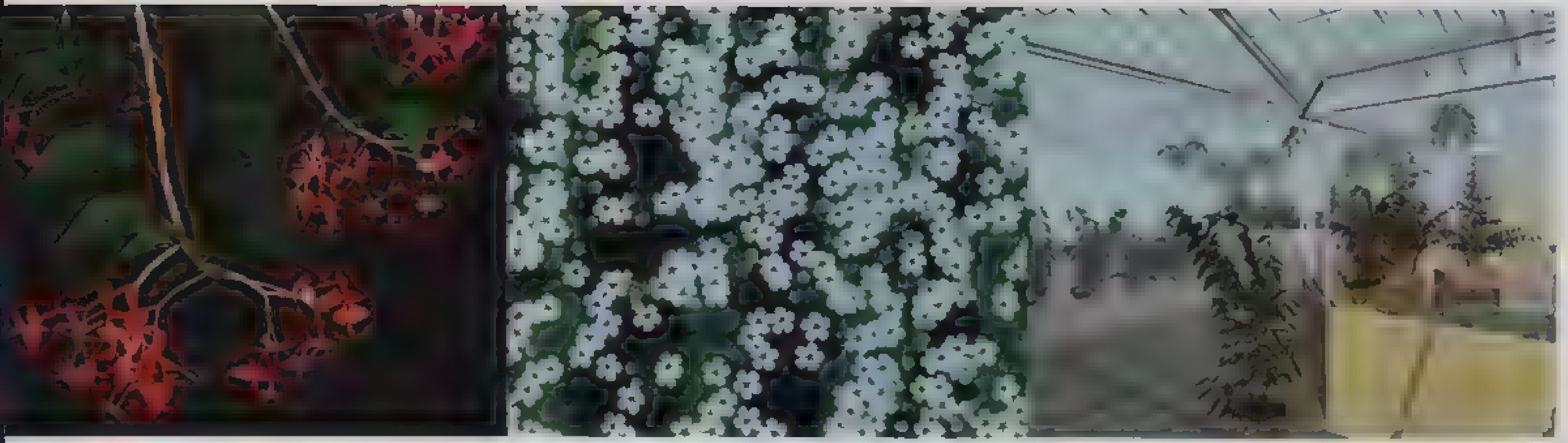
LandMaker serves as a 3D scenes editor for landscapes, gardens, interior decoration and urban scenery imaging. The Renderer provides fast realistic rendering options including shadows, texture mapping and fog. The Material module has a material characteristics editor for the renderer and the Glance module supports quick, interactive 3D visualization. A Cartoon module functions as an animation editor with a video interface to monitor the videotape recorder. AMAP runs on all Silicon Graphics workstations and generates both static and dynamic images that can output to printers or directly to film. Users can view their work either on the system monitor or on a VCR.

In addition to addressing the core issues of agriculture, forestry and environmental research, AMAP is being used for architecture, landscaping, urban planning, real-estate development, education and animation.

AMAP creates accurate simulations of plants to predict their behavior as crops. The software also can model the biological processes that regulate the interactions between host plants, pests, their predators and parasites. Additionally, it can predict plant behavior in urban or developed environments for long-term landscape management. And, if one wished, it could be used to grow trees in cartoons.

For more information about AMAP and its applications, contact: Pierre Dinouard, Laboratoire De Modelisation Cirad-Gerdat, BP 5035, 34032 Montpellier Cedex 1, France, (33) 67 61 59 95.

Pierre Dinouard is Manager of Computer Graphics at the Laboratoire de Modelisation, CIRAD-GERDAT. Patrick Renvoise is Silicon Graphics' Southern Europe Support Manager.



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The software has two main components; the AMAP Engine and Engine HQ and the AMAP LandMaker. The Engine serves as a plant growth simulator with 3D output in the form of a skeleton tree or plant figure. It receives information regarding the biological plant growth parameters from the Growth Database. The Terrain module generates terrain information with isovalue curves and filled surfaces. An Access module provides a CAD-CAM interface and the Figures module has a quick 3D modeler for geometrical patterns such as leaves and fruit.

LandMaker serves as a 3D scenes editor for landscapes, gardens, interior decoration and urban scenery imaging. The Renderer provides fast realistic rendering options including shadows, texture mapping and fog. The Material module has a material characteristics editor for the renderer and the Glance module supports quick, interactive 3D visualization. A Cartoon module functions as an animation editor with a video interface to monitor the videotape recorder. AMAP runs on all Silicon Graphics workstations and generates both static and dynamic images that can output to printers or directly to film. Users can view their work either on the system monitor or on a VCR.

In addition to addressing the core issues of agriculture, forestry and environmental research, AMAP is being used for architecture, landscaping, urban planning, real-estate development, education and animation.

AMAP creates accurate simulations of plants to predict their behavior as crops. The software also can model the biological processes that regulate the interactions between host plants, pests, their predators and parasites. Additionally, it can predict plant behavior in urban or developed environments for long-term landscape management. And, if one wished, it could be used to grow trees in cartoons.

For more information about AMAP and its applications, contact: Pierre Dinouard, Laboratoire De Modelisation Cirad-Gerdat, BP 5035, 34032 Montpellier Cedex 1, France, (33) 67 61 59 95.

Pierre Dinouard is Manager of Computer Graphics at the Laboratoire de Modelisation, CIRAD-GERDAT. Patrick Renvoise is Silicon Graphics' Southern Europe Support Manager.

The Human GENOME Initiative

BY JAMES M. AVERBACK

ACCORDING TO NOBEL LAUREATE JAMES WATSON, THE HUMAN GENOME MAPPING PROJECT — THE DEVELOPMENT OF A "BLUEPRINT" OF OUR SPECIES' GENETIC CODE — MAY RESULT IN THE CREATION OF THE "ULTIMATE

TOOL FOR UNDERSTANDING OURSELVES AT THE MOLECULAR LEVEL." A CRUCIAL REQUIREMENT OF THE PROJECT WILL BE THE ABILITY TO MANAGE MASSIVE AMOUNTS OF INFORMATION AND QUICKLY DETERMINE ITS MEANING.

At the Fels Institute, Temple University School of Medicine, eight faculty and more than thirty support personnel are involved in a major effort to elucidate and study the Human Genome (a complete "set" of the chromosomes in a human cell) as part of a new worldwide effort to document the genetic programming responsible for human beings. In the near term, this information will be invaluable for biomedical research and used to identify individuals with genetic susceptibility to known diseases. In the long term, it will open a new approach to medicine where gene modification will be used as a therapy. The importance of this work cannot be overstated. It will have a direct impact on our understanding of cancers such as leukemia, diseases of the nervous system such as Parkinson's disease and others of the approximately 4,000 diseases known to have a genetic origin, and more still in which genetic factors seem to play a role.

What makes us what we are? Is it possible to engineer changes? These are the primary questions that will be addressed by the Human Genome Project.

In the United States, Human Genome work is sponsored under a joint agency project managed by the National Institute of Health and the Department of Energy. The initiative is a "super" project established by an act of congress and funded in excess of $200 million annually for fifteen years. Mapping and sequencing the human genome is only the first part of the initiative. Those two components alone will constitute a massive undertaking which will not be completed until after the year 2000. It will be necessary to map and sequence over 100,000 genes composed of unique strings of four basic nucleotides appearing some 3 x 109 times to describe the entire genome. Needless to say, the vast majority of information will not be in DNA sequence, that is, the database of all nucleotide sequences, but rather the gene knowledge base containing information describing each gene, where it occurs in the genome and what is known about its function. Utilizing the information will present us with a distributed database problem equal in scope with any yet seen. This work is being carried out in numerous centers across the nation, further complicating the problem of database management.

The second phase consists of two fundamental questions: Can we relate this genetic information to our observations of human disease? And is it possible to predict the effect of a genetic mutation? These questions will occupy biomedical research for centuries.

The Human Genome Initiative will first build the library of human DNA as an (inter)national informatics resource and, second, sponsor development of tools to analyze and understand this data. Building the library means that many large, heterogeneous databases must be constructed to contain all of the gene map and sequence information. These databases must then be integrated to form a very large distributed database that will be accessed by an international community. At the same time, scientists wishing to utilize this information must learn how to access it, as well as develop systems to help visualize and understand what it means.

THE HUMAN GENOME PROJECT: ITS MEANING FOR COMPUTER SYSTEMS

Clearly, the human genome presents an enormous body of information to manage. However, metaphorically speaking, it is really just the DNA of the problem. That is, in the same way that DNA encodes the complete bio-chemical program of life, but does not make obvious its algorithm, solving the information capture and representation problems of the human genome initiative are necessary, but preliminary, to the real problem of understanding what the data means.

At Fels we are addressing the task of compiling a section of the genome library and, simultaneously, conceptualizing, building and using systems to analyze it. The work which has been proposed for funding will generate relational databases of DNA sequences and mapping information (ASCII), free form text (ASCII) and numerics (integer and real). Binary images will be generated of restriction digest gels which are scanned and converted into vectors to represent a "genetic fingerprint" of the clone or piece of genome from which they

came (see Figure 1). These fingerprints are then compared by computer to find overlaping genome segments which ultimately will generate a genetic map of the genome.

GEL IMAGING WORKSTATIONS

Within Fels, which will be one of many human genome centers, we will utilize a network of computers of varying configurations, functional specificity and cost. Starting at the raw data collection end of the problem, for gel image capture and analysis we will use Silicon Graphics 4D/25GT workstation(s) with integrated imaging camera/laser scanners and high speed image capture hardware. The workstations are configured with large physical memory for image manipulation and large disk capacity for interim online image storage. The 4D/25GT workstation will utilize X Windows to implement existing image analysis software, (see Figure 1). Multiple workstations will share a single image capture facility allowing us to take maximum advantage of shared equipment. Both the raw images and the processed fingerprint records can then be distributed over our Ethernet for long term storage and further processing. Image capture and analysis will be provided by the Visage System from Milligen/Biosearch. Visage is being ported to X Windows and the IRIS workstation family. It utilizes either a high resolution laser scanner or CCD Camera to capture high resolution images up to 11 x 17 inches.

DATA COMMUNICATIONS

As is the case with all systems in the project, the gel imaging workstation(s) will be connected via Ethernet to the main database service, (Silicon Graphics 4D/280GTXB) as well as individual scientists' workstations of varying configuration, and the Internet. Data communications in this project is essential both within Fels for cost effective sharing of computational machinery and outside of the institute for real time sharing of information.

In fact, international data communications is becoming a standard tool in biomedical research with applications ranging from electronic mail to real time access of distributed databases. Compliance with Internet data communications standards is an essential component for all workstations and is needed to provide reliable database access within Fels and with other genome centers. We will utilize the TCP/IP protocols with Telnet, FTP, and NFS applications.

COST EFFECTIVE-STANDARDS COMPLIANT WORKSTATIONS FOR ANALYSIS

High performance, standards compliant and cost effective graphical workstations are an invaluable tool in this work. High performance graphics are used to symbolically represent enormous volumes of data. For example, there are twenty-three chromosomes in each of us, even the smallest of which contains some fifty million nucleotides organized into

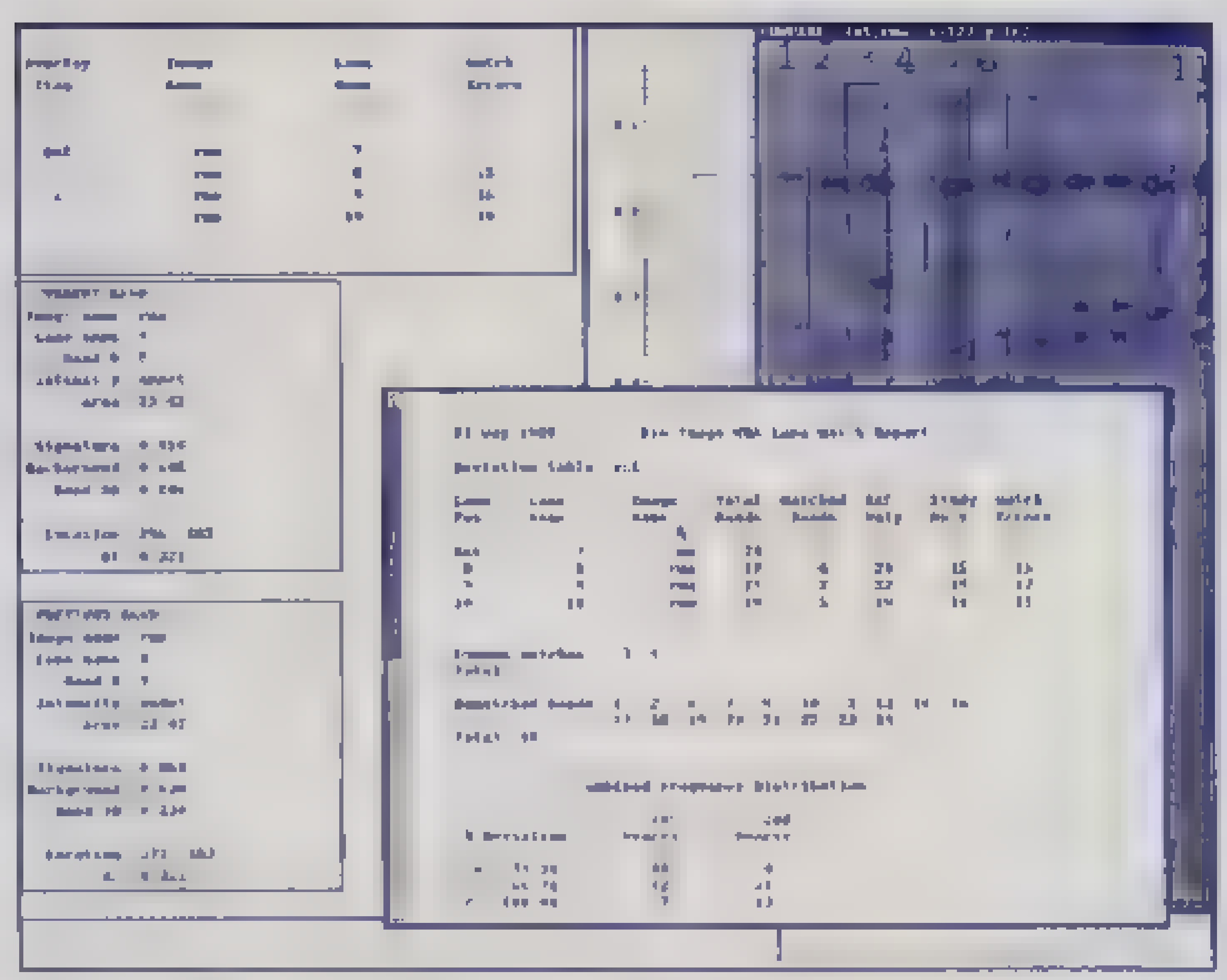


Figure 1. Restriction Digest Gel
Image analysis reveals that each fragment of a chromosome presents a "fingerprint" which uniquely identifies it and its position relative to adjacent overlaping fragments. Generating a database of fragments representing an entire chromosome is the first task of the Human Genome Project. The computer will then be used to order the fragments according to position on the chromosome. *Photo courtesy of Bio Image Products.*

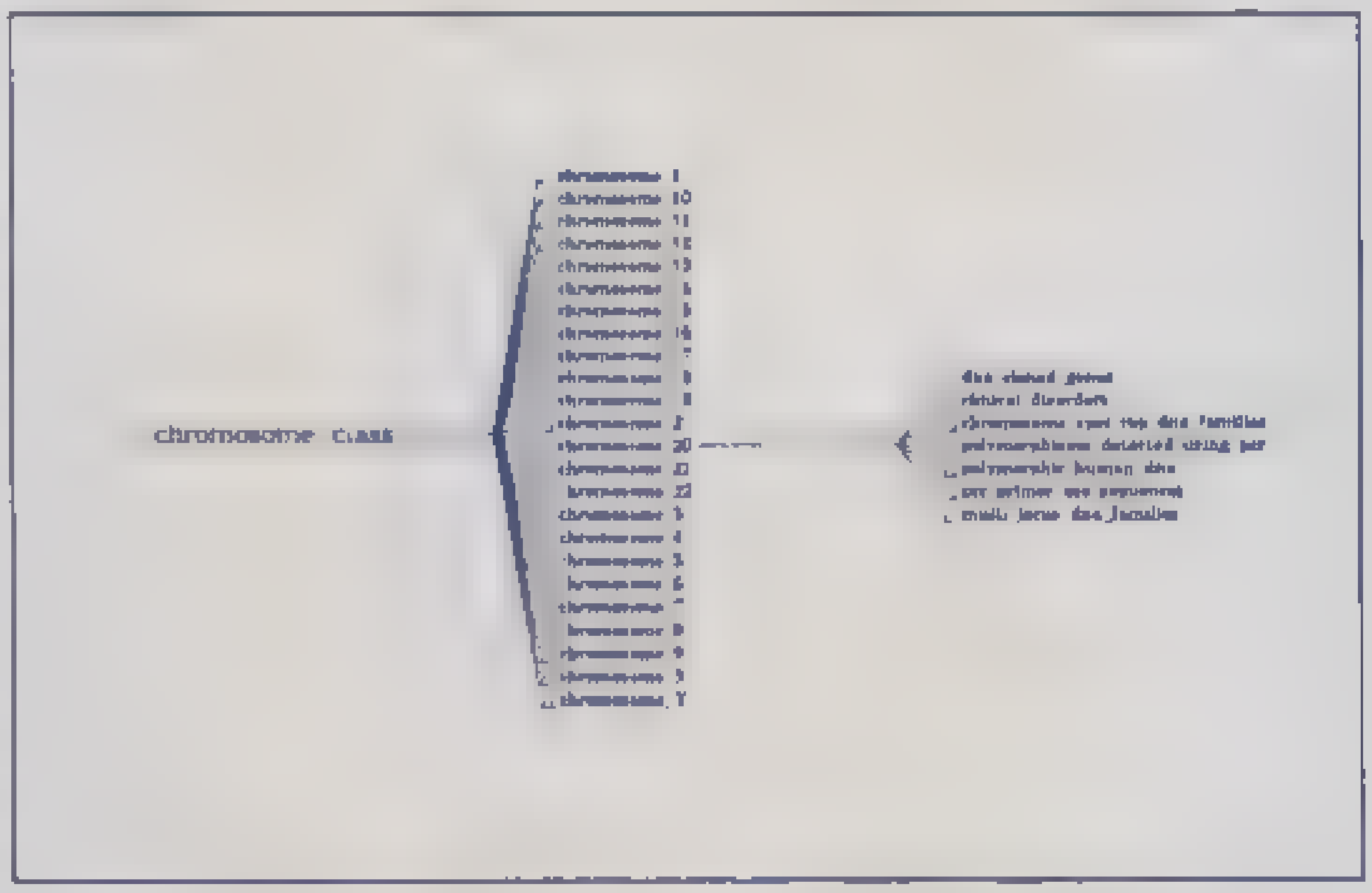


Figure 2. An Object Oriented Chromosome Knowledge Base
An "Object Oriented" representation of information to be collected during the Human Genome Project. Locus tables will be generated for each chromosome. While presented here as an object model, all data is actually stored in the Oracle Relational Database. The object oriented environment is presented by the "Nexpert Object" Knowledge Processing System running on a Silicon Graphics 4D/280GTXB.

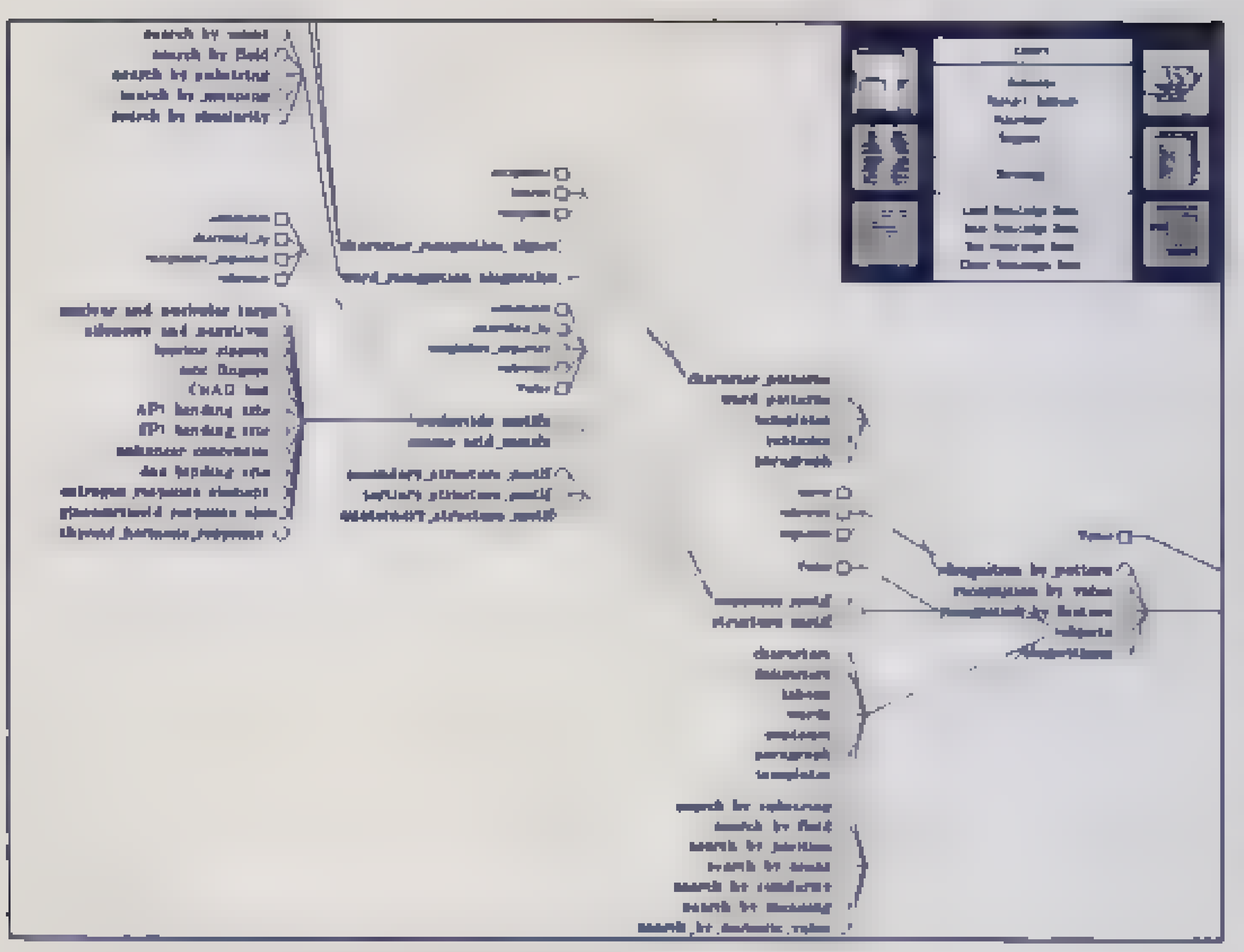


Figure 3. The Knowledge Network
A subset of the "derivation tree" used to recognize important sequence and structural domains within chromosome fragments. This network is declarative in that it presents the logic of our analysis and procedural in that it is, in fact, a component of the logic program itself. This derivation tree is implemented in the Nexpert Object Knowledge Processing System running on a Silicon Graphics 4D/25 GT Personal IRIS.

thousands of genes. As it is necessary to know the relative positioning and proximity of these genes on a given chromosome we will use symbolic views of the data space. That is, one will "zoom" into the detailed data for a specific gene while at the same time seeing higher level views of adjacent genes in our "chromosome browser." As this data will be used in a variety of ways, our system must be present on workstations with high to low cost factors all of which allow the data space to be transcended easily and in a conceptually consistent manner by scientists with a wide range of backgrounds. We will be using the Silicon Graphics Personal IRIS workstation for this purpose with configurations ranging in cost from $15,000 to $45,000. Both performance and configuration flexibility are essential considerations here. We will also use low end Apple Macintosh computers running X Windows servers to access the data space utilizing the same application software.

THE PRIMARY DATABASE SERVICE

The relational data model will be used to provide primary database services for all of our applications. The system is serviced by a relational database engine capable of operating in a distributed manner on all platforms throughout the network. The ability to distribute information is essential, our database service must transparently link multiple databases on multiple platforms at high and low cost factors. Reliability and crash recovery functions are required at the system level. A system crash on one platform must be recoverable and must not jeopardize database components on other machines.

Cost effective and standards compliant operation requires that the database server must be operable under UNIX, VMS, DOS and MacOS environments. The primary database server will be a Silicon Graphics 4D/280GTXB configured with 128 megabytes on main memory as well as 2 gigabytes of SMD disk for data storage and 2 gigabytes of IPI disk for server operations. A version of the Oracle Relational Database Management System has been "parallelized" by Silicon Graphics to provide a high performance database server. We will also run Oracle locally on our Personal IRIS image analysis workstations and even on some of our Apple Macintosh systems to provide a standardized database environment.

OBJECT ORIENTED DATA VISUALIZATION

Symbolic visualization of the data space is implemented utilizing an "object oriented model" with a graphical user interface. Ultimately, scientists at Fels will see genes as objects with a wide variety of information attached as properties and "child" objects. Similar gene objects are associated by formation of "classes" which may be declared prior to, during, or after data collection.

On a national scale, a scientist will see chromosome objects that are comprised of gene objects that in turn exhibit various properties, some of which are in common with other genes and, hence, share a common class relationship, (see Figure 2). Most of the genetic information will be generated from the bottom up and will be added as we learn more and more about a gene. Hence, forward and backward inheritance of properties and class relationships will be essential. The object environment is served by the primary relational database service which will be optimized for efficiency of storage while the object environment will be optimized for user interaction. Our object oriented environment is provided by the Nexpert Object package from Neuron Data. Nexpert Object gives us a sophisticated SQL Bridge to Oracle and an "inference engine" for logical processing. Access to large main memory on the Personal IRIS workstations will be essential for this environment as the data space and graphical processing requirements grow. Initially, we will need 16 to 32 megabytes of main memory on a typical workstation with up to 64 megabytes required on the image processing and high level analysis systems.

THE KNOWLEDGE NETWORK: HOW WIDE? HOW TALL?

As we begin to understand the problem of collecting, cataloging and analyzing a genome of information, it is clear that our systems must continuously evolve. These systems will get wider in terms of range of functionality and taller in terms of

range of performance and cost factors. New approaches to machine intelligence, data visualization, human interface and data collection technologies are continually becoming available and present less expensive and more efficient solutions. We will see ongoing improvement in hardware, software and analysis algorithms throughout this project and further expect that other genomes will also be mapped and sequenced utilizing these systems far into the future. Hence, we position ourselves with systems that work today but lend themselves to evolution.

At Fels we have already begun development of the central player around which the rest of the system integrates, the knowledge workstation (see Figure 3). We have designed our system around the Silicon Graphics Personal IRIS workstation. These are knowledge-based systems utilizing dedicated artificial intelligence environments and running on high performance graphics oriented workstations. Around this core is assembled a network of systems which are optimized as database and compute servers, (Silicon Graphics 4D/200 series), for a well defined range of computing problems. In effect we have implemented a heterogeneous distributed network of systems focused on the knowledge workstation. With the evolution of our genomic knowledge, will come increasing database, computing, graphic, application development and knowledge processing needs which will be met by adding, replacing or upgrading network components. In Tables 1, 2 and 3 we have compared the performance and configuration requirements of the knowledge workstation as we use it today with what we will need by 1992. In Table 4 we outline performance requirements of the network to support this architecture today versus that needed by 1992.

The Human Genome Initiative is a project of fundamental import to biomedical research and medicine. It will result in development of massive bio-informatics systems requiring high performance graphical, database, compute and communication services. While computing machinery available today provides a reasonable starting point, it is clear that the genome project will demand ever increasing performance, capacities and programming productivity. Silicon Graphics' computer systems present a well integrated range of systems from workstations to compute servers. In five years, we will require systems with two to four times the graphics and cpu processing speeds of today's most powerful machines. As more and more is demanded of graphics for communication of concepts and data visualization, the performance and easy upgrade path of the IRIS architecture will be of growing importance.

James M. Averback is the Director of the Laboratory of Applied Computing at the Fels Institute for Cancer Research and Molecular Biology, Temple University Medical School.

Table 1

Performance of a Knowledge Workstation

Performance:	Present	By 1992
MIPS[1]	20	32
MFLOPS[2]	1.6	8
Graphics		
Vectors[3]	200K	500K
Polygons[4]	24K	150K

Table 2

Hardware Configuration of a Knowledge Workstation

Configuration:	Present	By 1992
MBytes Physical Memory	16	64
GBytes Disk Memory	.5	2
MBit/sec Network Interconnect	10	100
19" Hi Resolution Color Screens	1	1-4
Keyboard	1	1-4
Mouse	1	1-4
Digitizing Tablet with Pen	No	Yes
Image Scanner (24 bit)	No	Yes
Projection Output	No	Yes
Multi-media Interface		
Video (NTSC)	No	Yes
Audio	No	Yes
Fax Interface	No	Yes
Standards Compliant, High Performance, and "Application Specific" Co-Processor Bus	No	Yes

Table 3

Software Configuration of a Knowledge Workstation

Configuration:	Present	By 1992
Unix Operating System	Yes	Yes
Window Interface	NeWS	X
Window Manager	uwm	Motif
Object Oriented Knowledge Base	Yes	Yes
High Performance Distributed Relational Database	Yes	Yes
Inference Engine	Yes	Yes
CASE Tools for Symbolic Programming in:		
1st Order Logic and Knowledge Base Inference	Yes	Yes
C, Fortran, Pascal	No	No
Database Services	Yes	Yes
Network Services	No	Yes
Numerical Analysis	No	Yes
Statistical Analysis	No	Yes

Table 4

Network Performance for a Knowledge Workstation

Configuration:	Present	By 1992
Peak Bandwidth (MBits/sec)	10	100
Sustained Average Bandwidth	1	10
Users Connected	5	100
Average Number Simultaneous Users	2	50
Peripherals Connected	10	100
Average Number Simultaneous Peripherals	2	10
$Cost/Connection	$700	$500
Topology	Driven by Cost	Driven by Cost

[1]Mips (VAX Dhrystone) [3]Graphics Vectors/sec (24 bit color)
[2]MFLOPS (DP Linpack) [4]Polygons/sec (10x10 pixel, 24 bit color, Gouraud, Lighted)

Visual Processing

Cockpit simulations like this one are used by Qantas Airlines at its pilot training center in Sydney.

In The LAND DOWN UNDER

Like the United States, Australia is a young country and, like youth itself, quick to embrace new and innovative technologies. It's no surprise, then, that visual processing workstations are widely used all across the vast, future-looking southern continent.

BY HANNAH WATTERSON

Over the last three years, universities, businesses, and research organizations throughout Australia have invested in Silicon Graphics computers to run a wide variety of complex applications. Now that investment is reaping a return as the use of visual processing workstations helps facilitate major advances in science, medicine, engineering, mining, architecture, design, visual simulation, image processing, mathematical modeling, and art.

SCIENCE AND MEDICINE

More than 25 percent of all the Silicon Graphics computers in Australia have been purchased by universities. The majority of these schools are using the systems for research and development in the scientific and medical fields.

The Department of Biochemistry at the University of Sydney, New South Wales, uses a Personal IRIS workstation for cancer research. The system's ability to display three-dimensional structures of macromolecules, such as DNA and proteins, and its ability to show how the cancer-related proteins bind to DNA, has enabled the department to make significant advances in this area. The university is also using the system to visualize the action of inhibitors (substances that block biochemical reactions) and substrates (normal substances) with enzyme active sites (surfaces or environments that support biochemical reactions).

North of New South Wales, Bond University in Queensland is carrying out molecular modeling projects for research into cancer treatment and antiviral drugs for possible use in combating AIDS. The university's Graduate School of Science and Technology uses the workstations' graphics to model targets for drugs in the body. These targets are primarily protein molecules that are visualized on the system.

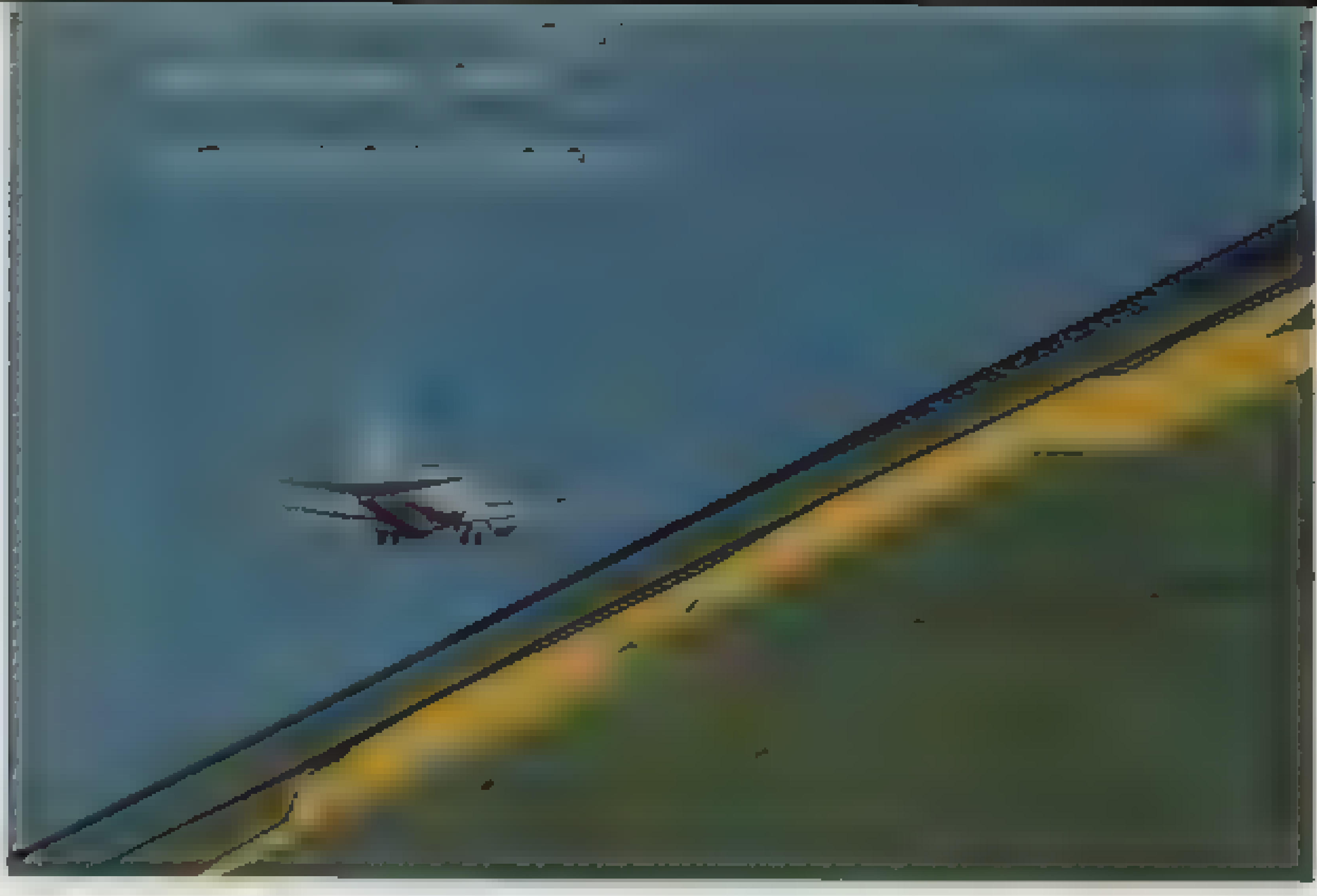
Researchers at Bond are in the process of developing a 3D model that predicts the way in which proteins on the outside of the AIDS virus interact with the human immune system. In addition, Bond is using the Silicon Graphics workstations to develop drugs that will inhibit replication of the AIDS virus in cells.

DNA and malignant cells are also the focus of a project at the University of Western Australia. There, researchers are using superworkstations to make 3D reconstructions of human cell structures, looking at active and inactive DNA so that pathologists can see whether or not cells are malignant. In addition, the systems are being used to display and analyze the structures of small proteins in solution from nuclear magnetic resonance (NMR) data, and to identify the essential parts of these compounds.

At the Victoria College of Pharmacy Limited in Victoria, researchers are working on a computer-assisted drug design project. Key areas of interest include drug receptor modeling and the structure activity relationships of central nervous system (CNS) drugs, peptides and neurotransmitters. This has involved the study of topographical arrangements of an aromatic group and a nitrogen atom which are common features of the majority of CNS-active drug classes.

Using computer graphics, researchers established that there was a remarkable similarity in the topographical arrangement of these groups in low-energy conformation of representative

"Cash In" by Australian artist Richard Guthrie, produced on a Personal IRIS workstation with software from CDI Technology and printed on a Michelangelo inkjet printer.



Australia's Bureau of Air Safety in Canberra uses the data from digital flight recorders, known as "black boxes," to create simulations which aid in the study of air disasters.

compounds from fourteen different CNS-active drug classes. This kind of data has been critical to the construction of drug design models.

At St. Vincent's Institute of Medical Research in Melbourne, an IRIS 4D/GT workstation is being used in X-ray crystallography studies of the human hCG reproduction hormone. In addition, the institute is using the system in modeling studies of protein kinases.

An installation of a 4D/220GTX processor at the Cranio-Facial Unit in Adelaide has enabled this extraordinary medical unit to employ medical imaging in the highly-complex planning of reconstructive cranio-facial surgery.

Visual processing is a vital element in planning the treatment of various medical conditions such as cranio-facial deformations and injuries. Numerous hospitals and medical research facilities use 3D workstations, among them Adelaide's Australian Cranio-Facial Unit.

ENGINEERING

Engineering has been the focus of several other university research projects in Australia. The Electrical and Electronic Engineering Department of the University of Western Australia is using the workstations to display simulations of the way in which the brain behaves. Researchers are using artificial neural networks to train the computer to recall information. The artificial neural network simulations have been used in applications including speech and speaker recognition and image compression.

Robotic automation simulations, solids modeling, finite elemental analysis and advanced computer-aided engineering are the main areas of research at the Footscray Institute of Technology. One research project involves the study of the design of truck wheels. Patran software is used to create a solids model and finite element mesh. The interactive graphics allows the researcher to see the model and the mesh grow. A second package performs the finite element analysis. The results are then sent back to Patran for post-processing.

Various loads can be applied to the wheel for further design analysis. Researchers are able to simulate the effect of making the entire wheel one millimeter thinner and can increase the load until the wheel fails. The system also simulates cornering loads and performs rotations.

MINING

The New South Wales Joint Coal Board runs Vulcan software on a 4D/20GTXB system to help manage its coal resources. Borehole data is processed and displayed for viewing by cross-section. The data relates to the position and depth of the coal seam and the quality of the coal resource found there. The Joint Coal Board has built up a Coal Resource Database System (CRDS) and is using it to create projections of subsidence throughout the region as well as the evaluation of coal quality. This work will help the Joint Coal Board match its coal quality with the parameters required by the international coal market.

ARCHITECTURE

Two architectural packages that run on the Personal IRIS workstation provide 3D visualization and animation. Sonata 3D building modeling software, from t Solutions in the U.K, enables architects and designers to produce animated models on the system, showing multiple light sources and corresponding shadows and textures. Caddsman Architect, by The Cadds Can Ltd. based in Adelaide, provides total integration of architectural procedures from initial concepts through "as constructed" drawings, and real-time 3D walk-throughs.

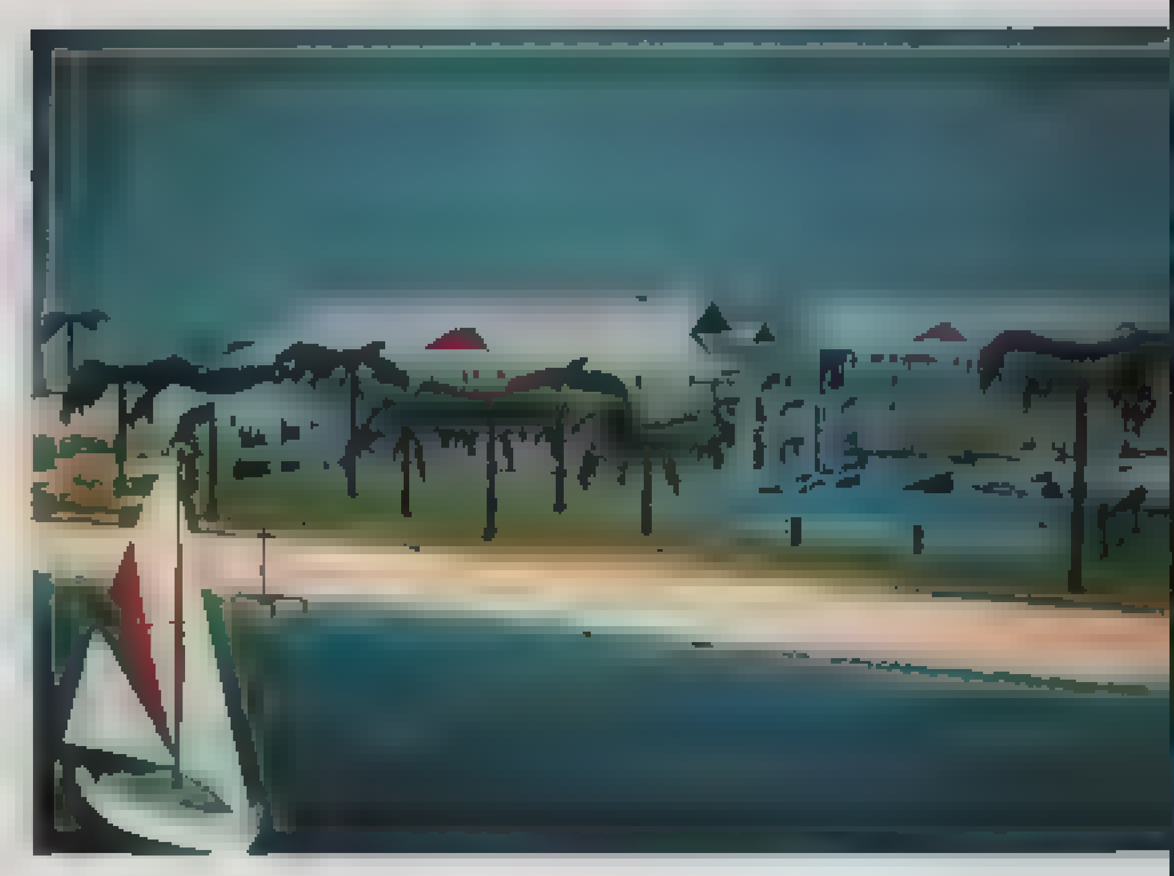
DESIGN

Containers Hi-Tech Pty Ltd (CHT), based in Hurstville, Sydney, is using a 4D/70GT workstation, Pro-Engineer 3D CAD software and the Australian flow analysis software, Moldflow, for design and design analysis of plastic containers. The system supports concept, design, thermal analysis, flow analysis and structural analysis. It provides solid or volumetric models instead of planar elements and allows the user to drive the geometry by altering the dimensions. Given accurate input, the system can predict design and production specifications, including: weight, cycle time, all the pressures and the melt temperature.

VISUAL SIMULATION

Qantas Airlines is using two IRIS workstations to produce the image database for the Link Miles Image IV Visual System that is fitted to the B747-400 Fuel Flight Simulator. The system provides the full range of flight movements and shows pilots a day or night view of

Container Hi-Tech in Sydney used an IRIS 4D/70GT workstation, Pro-Engineer 3D CAD and Moldflow software to design a new plastic paint can.



A rendering of a Queensland resort hotel produced on a Personal IRIS workstation running Sonata software.

Qantas destinations worldwide from the simulated cockpit . Fully-shaded and lighted solid objects can be moved around the screen in real-time by the operator.

In Canberra, The Bureau of Air Safety Investigation (BASI) is using a 4D/70GT graphics workstation and software developed by Garrard Consulting, for its air accident investigation system. The system translates the information from an aircraft's "black box" digital flight recorder (which was invented in Australia) into a realistic animated representation of what happened in the moments prior to an accident. By using maps, digital terrain data, weather information and eyewitness evidence, the system can recreate the precise physical environment through which the plane was flying. By adding data from ground-based recorders and aircraft performance and operational information, an incident can be reconstructed from several points of view: the pilot's, the air traffic controller's and the eyewitnesses' on the ground. Multiple scenarios are possible. In addition, the system can recreate weather conditions, such as fog, clouds and lightning.

A visual representation of the information in a digital flight recorder can be created within an hour after BASI receives a black box. Representations of the external environment require about a week. The visualization can be output directly to videotape for immediate viewing.

IMAGE PROCESSING

Definitive Image Technology Pty. Ltd. of Melbourne uses a 4D/240S system to process files and manipulate photographic images. What used to require two-and-a half hours can now be accomplished in six to twelve minutes. The system produces an electronic image of such high resolution that the output original contains finer resolution than the film is capable of recording.

Both the University of Technology, Sydney (UTS) and Western Australia's Curtin University have image processing projects of a different nature underway. UTS is looking at the mathematical manipulation of images to improve or enhance detail, while Curtin's Image Processing and Analysis Laboratory (CIPAL) has targeted several emerging industrial applications for remote sensing and robotics. These include pattern recognition, image analysis and enhancement and medical imaging.

Taking image recognition a step further, the Intelligent Robotic Research Center in Monash University's Department of Electrical and Computer Systems Engineering is using Silicon Graphics' systems and an Androx image processing board to research computer vision, tactile sensing, robot control and robot navigation. By combining range and image data for analysis and recognition of objects, the researchers can use the results to manipulate those objects with robots.

MATHEMATICAL MODELING

At the Research and Development Department of the State Electricity Commission of Victoria (SECV), researchers are using a 4D/240S workstation to develop new mathematical models to support ongoing R&D. Areas of interest include stress analysis of major plant items and modeling of fluid flow and heat transfer processes in boilers and associated equipment. They are also using the system to model atmospheric dispersion processes and the chemical kinetics of combustion.

ART

The purely artistic use of visual processing workstations in Australia is just as interesting, valuable and socially significant as the technology's scientific and technical applications.

Australian artist, Richard Guthrie uses a Personal IRIS workstation, CDI Technology software, and a Michelangelo inkjet printer to create art. His technique involves manipulating well-known images — in the example on page two, American movie star Jack Nicholson — so as to cause the viewer to assess modern society's icons.

"The technology complements my art," Guthrie comments. "It allows me to access images and manipulate them at will, file the images as they develop, see their development stage by stage and have instant control of my work."

And that nicely sums up the value of visual processing for most who work with it, wherever they may reside — from Los Angeles to London, from the Land of the Rising Sun to the Land Down Under.

For more information regarding visual processing in Australia, please contact Silicon Graphics' Southern Pacific Headquarters, 98 Alfred Street, Suite 19, Level 5, Milsons Point, NSW 2061, Australia. Telephone: 61-2-959-3349.

Hannah Waterson is Director of Cooper Associates Pty. Ltd , North Sydney, New South Wales, Australia. Ms. Watterson is the former editor of Australia's Computer Graphics Technology *magazine.*

TAKING FLIGHT

THE MAKING OF A SIMULATOR

BY JOSHUA MOGAL

In February of 1990, a new idea was born. It was that a standard, commercial off-the-shelf computer workstation could be used as the basis of a complete simulation system, lowering overall costs through standards and volume production.

- *February, 1990: Silicon Graphics announces the PowerVision™ system.*
- *June, 1990: First PowerVision system shipped.*
- *December, 1990: 1000th PowerVision system shipped.*

Visual simulation is Silicon Graphics' largest overall market. This volume of business has been achieved through the sales of systems for use in instructor/operator stations (IOS), cockpit prototyping, and database development. With the 1990 introduction of both the REACT™ real-time UNIX subsystem and the high-end VGX graphics systems, it was possible to enter into the remaining segments of the visual simulation market, and achieve real-time simulation (computation) and the Out-The-Window (OTW) visuals.

The demands of an OTW system are stringent, requiring scene update rates of twenty to sixty frames per second. These scenes must provide the correct cues to the trainee, including such features as realistically texture-mapped terrain and atmospheric effects. The VGX technology is the first general purpose graphics product on the market capable of achieving these goals, and at a fraction of the price of existing Computer Image Generators (CIGs).

Concept

October, 1990 - Mountain View, California. The Interservice/Industry Training Systems Conference in Orlando, Florida is one month away. A group is formed to demonstrate to the simulator industry Silicon Graphics' impressive hardware and software capabilities. The decision is made to integrate an entire simulator and demonstrate it at I/ITSC '90. A new simulation lab is established and stocked with three 4D/300 Series VGX graphics supercomputers (with MultiBuffer), two Personal IRIS workstations, three Electrohome 4000 multisync projectors, and a three-segment wraparound projection screen.

With the real-time and visual systems in place, various Geometry Partners are contacted and invited to participate in the integration effort. Within a week, BVR of Israel agrees to provide an F15 cockpit, the real-time simulation and gaming code, and the IOS; Gemini Technology Corp. (GTC) offers to add their image generation package (the Generic Visual System - GVS) to the fray; Paradigm Simulations Inc. (PSI) brings their AudioWorks 3D sound generation and imaging package along with the sound synthesis and speaker systems, and Systran Corporation donates their SCRAMnet fiber-optic reflective shared memory system. The team is assembled.

I/ITSC minus 21 Days

The hardware is capable. The individual software packages are proven, aside from the newcomer Paradigm (which will make its big first impression with this simulator). Yet the integration task lies ahead and none of the team players has had any previous contact with one another prior to this project. Individuals are not getting paid for their efforts, but the challenge of the task and the opportunity it promises provide ample incentive.

Representatives from Gemini Technology Corp meet with the Silicon Graphics' Advanced Systems Division (ASD) engineering team just three weeks prior to the show: the project begins. Gemini starts things off, setting out to develop both the necessary database for the fly-through and to get the three VGX workstations running synchronously in order to display the three separate CIG channels. Since the GVS package, now called the Simation Series on the VGX workstation, is already capable of synchronization across multiple systems, the primary challenge is getting onto SCRAMnet from Ethernet. Thanks to the simplicity of the SCRAMnet model, utilizing UNIX interprocess shared memory partitions, this task is completed quickly, leaving more time for performance tuning, database development, and planning for the integration into the actual simulation code to be provided by BVR.

Aside from simply providing the hardware base, Silicon Graphics also has a hand in the integration. The ASD engineering team is charged with offering any assistance necessary to help Gemini and the others, both with the hardware and with the never-ending task of tuning the performance of the software to squeeze every last vector-, polygon-, and frame-per-second out of the simulation code.

Working independently at first, Paradigm soon steps in with their Emax sampling synthesizer, connected to one of the Personal IRIS workstations running PSI's AudioWorks software. AudioWorks complements the Graphics Library™, providing a library of routines for the specification of sounds, their volume, pitch, and an indication as to

which 3D objects they are attached (along with a velocity to allow for Doppler effects). Adding their pre-sampled library of sounds for jet engines, landing gear deployment, tire screeches on runways, and hydraulic actuators, an instant environment is created as these sounds combine and blast their way through the quadrophonic sound system, out of the lab, and throughout both floors of the ASD building.

With its Middle Eastern location making it the team member most distant from Mountain View, interacting with BVR requires a bevy of faxes and Federal Express packages. Finally, at the beginning of October, one of BVR's key technical staff members flies to California to join the integration team. Bringing the BVR software with him, he begins by first bringing up their simulation program and IOS as they currently run, then delving into detailed discussions with the Gemini personnel to determine how best to bring in GVS as the new visual system. Messages from both BVR and Gemini will subsequently drive the AudioWorks sound system which occupies one of the four parallel processors in the main simulation system, a 4D/340VGX workstation.

I/ITSC minus 12 Days

In one week's time, we have three visual channels up and running. The simulation code, ported not a month earlier from an Apollo, is running smoothly at up to 200Hz. The sound system is working with both GVS and BVR, running off a serial port on the 4D/340VGX workstation. There are, however, synchronization problems. The handshaking between GVS and BVR is not always frame-matched due to the differences in speed between the simulation computational frame rate and that of the visual system. Additionally, the speed of the visuals at full-screen resolution (1280x1024) just isn't making the grade; frame rates are languishing at 10-20 Hz, above or below the cloud layer. This is unacceptable. The cockpit has just arrived and integration must begin immediately.

Paradigm's job is, for the most part, complete. It's been done in record time and with little more to do before opening the show at I/ITSC two weeks hence. BVR is split between their effort to integrate the physical cockpit and ironing out the synchronization issues with Gemini. Gem-

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Tokyo 150
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ini's energies are likewise split between their focus on synchronization and their focus on improving the frame rate.

The frame rate must improve. A minimum of 20Hz below the clouds and 20+Hz above must be achieved. The team agrees to sacrifice resolution for speed, taking advantage of the VGX subsystem's programmable video output formatter (VOF) to drive the multisync projectors at VGA resolution (640x480 at 60Hz). Without anti-aliasing, this could be a real problem, causing the generation of extensive artifacts and false texture cues. Fortunately, the VGX technology is up to the task. By providing standard filtering functions when applying textures to polygons, the textures are automatically anti-aliased as they are applied. Thus the image at VGA resolution is virtually indiscernible from its high resolution counterpart.

The advantage of the lower resolution is that the number of pixels needing to be filled when drawing textured polygons is cut by a factor of four. For applications in Visual Simulation and other markets served by the PowerVision machines, those that require large numbers of polygons or large polygons with applied textures can cause bottlenecks due not only to the transformations required for the polygon vertices, but at the back end of the pipeline when trying to fill in the pixels in the polygons being drawn. The MultiBuffer option helps tremendously here, doubling the pixel fill rate of a standard VGX system, yet this may still not be enough, requiring the application to drop down to some lower resolution. The combination of the MultiBuffer and the texture filtering, however, helps to overcome most of the drawbacks associated with running at reduced resolutions.

I/ITSC minus 10 Days

The cockpit is up. One of the Personal IRIS workstations is driving the IOS, showing the god's-eye view of the training scenario in 3D while the second Personal IRIS system has two of its RGB channels split off to drive the separate monochrome radar and navigation displays in the cockpit.

BVR and Gemini are finally synchronized and running through a variety of scenarios, from air-to-air combat to touch-and-go landings. The code is frozen. 'Safe' copies are made and distributed for delivery to I/ITSC. In less than two weeks, a complete F-15 cockpit simulator has been integrated and brought on-line.

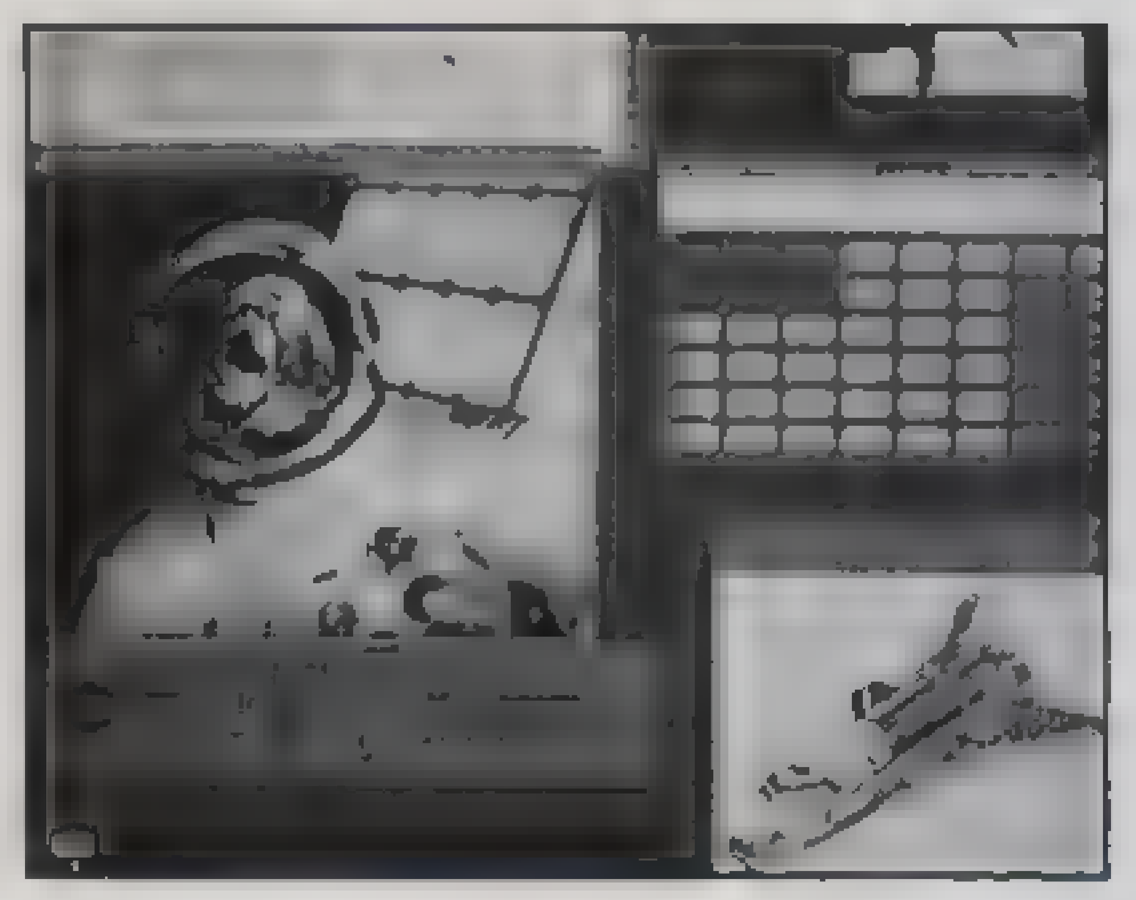
I/ITSC minus 8 Days

With only a week to go, the systems, cockpit and associated hardware is packed for the show. The first task is complete and the next begins. *It's Showtime.*

Joshua Mogal is a product manager for Silicon Graphics' Advanced Graphics Systems.

A new video is now available showing the integration effort and containing interviews with those involved. For information, please contact your local Silicon Graphics branch office or contact David Hughes at (415) 962-3519 or Joshua Mogal at (415) 335-1460. ●

Real Time Television On Workstations



The RGB/View System for Multimedia Effects

The RGB/View™ displays live TV or other full motion video on workstations and high resolution personal computers. The RGB/View accepts video signals (NTSC or PAL) from a built-in TV tuner, camera, tape recorder or videodisc. FLIR input is also available. True color video is displayed full screen or as a window on the monitor

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Applications include interactive video disk training, video teleconferencing, process control, surveillance, simulation, C³I and robotics.

The RGB/View may be retrofitted to existing display systems.

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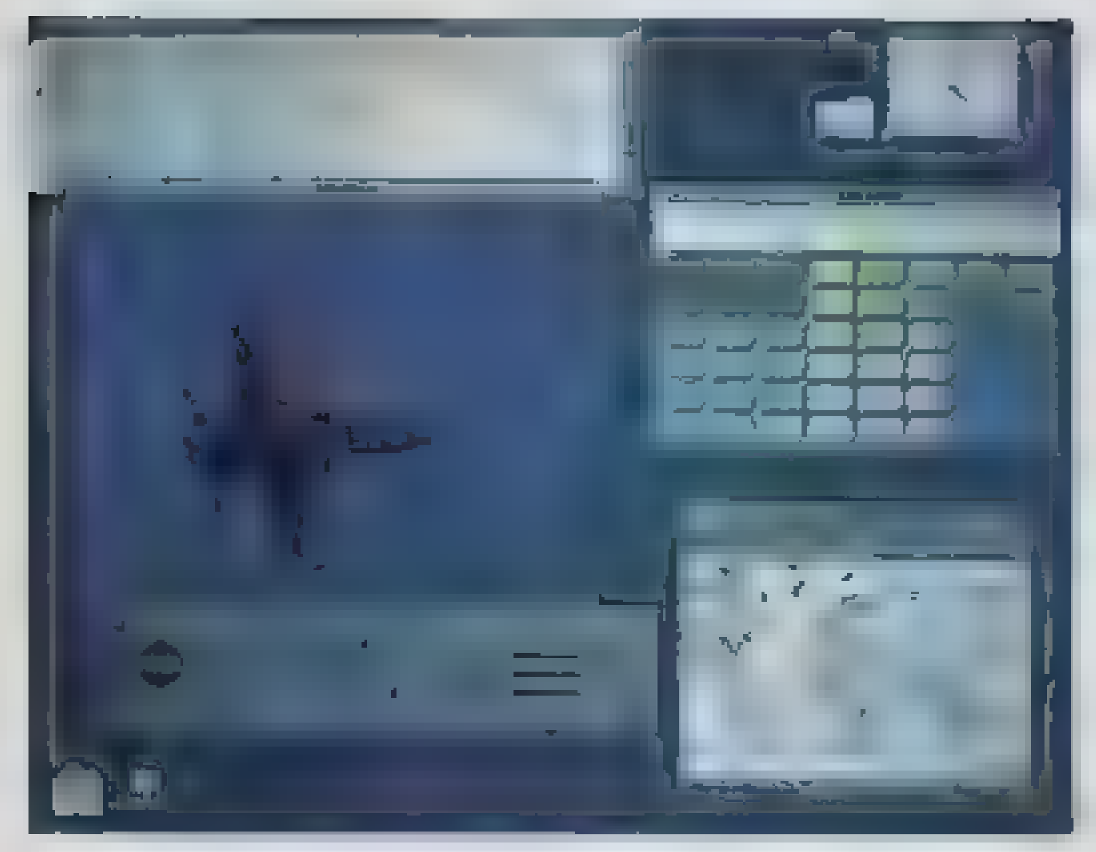

Video Display System with TV Tuner Opens Windows

RGB Spectrum has announced a new video windowing system with a built-in television tuner for workstations. The RGB/View 1050™ is a "stand-alone" peripheral which displays full motion video on the workstation monitor. The RGB/View 1050 is a table top or rack mountable unit with all window functions controlled via an RS-232 or SCSI port.

The television tuner accepts VHF, UHF, and cable TV 253 channel capability. This allows broadcast or cable TV to be monitored on the computer screen during normal computer use. The tuner can also be used to select a video source from a bank of cameras or video disc players over an in-house cable distribution system. The video signals are digitized in real-time for display as a full screen image or a repositionable, scaleable window on the workstation monitor. A superimpose capability allows computer generated graphics to be overlaid on the video. Stereo audio control capability is also available. Two NTSC (or PAL) composite video signals, one S-Video and one RS-170 RGB component signal may be connected simultaneously and switched under software control. Frame capture and transfer to and from a disc or network is achieved via a SCSI port. A firmware resident command line interpreter allows inclusion of video windowing functions in any application software.

For more information, contact: Carol Fogel, RGB Spectrum, 2550 Ninth St., Berkeley, CA 94710, (415) 848-0180.

ARC/INFO™ Announced for IRIS Workstations

Silicon Graphics and Environmental Systems Research Institute, Inc. (ESRI) have announced the port of ESRI's ARC/INFO version 5.0.1 to the IRIS 4D family of workstations and servers. ARC/INFO is used to automate, manipulate, analyze and display geographic data. As a supplier of Geographical Information Systems (GIS) software, organizations use ESRI software in applications requiring the management of spatial information. With ARC/INFO, users can develop new ways to apply the visualization capabilities of Silicon Graphics workstations to geoscientific data on a single desktop. Users include oil companies, mining companies, civil engineering firms, natural resource agencies and forestry companies.

For more information, contact: Jill Grossman, Silicon Graphics, (415) 335-1516 or Catherine Dorn, ESRI, (714) 793-2853.

Ten X Releases Optixchange™

Ten X announces OptiXchange, a multifunction optical subsystem for Silicon Graphics workstations. The OptiXchange is an optical disk subsystem that can read and write both erasable and WORM optical media. The product provides erasable media for backups and active files with numerous changes, and permanent media (WORM) for archival data.

Ten X subsystems include the Ten X Optical Conversion Unit, OCU, which provides "plug & play" compatibility for optical disk drives on any computer which supports SCSI Winchester drives. The drives require no software drivers or modifications to the operating system or application programs. The OCU provides greatly enhanced optical disk performance via nonvolatile data caching and hardware data compression. An automatic audit trail is provided by the Timestamp feature in WORM mode.

For more information, contact: Ten X Technology, Inc., 4807 Spicewood Springs Road, Bldg. 3, Suite 3200, Austin, TX, (800) 922-9050 or (512) 346-8360.

New Level of Visual Simulation System Offered

Virtual Prototypes, Inc. (VPI) and Gemini Technology Corporation (GTC) have announced completion of the integration of their two products VAPS™ and GVS™. This combination will allow rapid prototyping of man-machine interfaces, such as airplane cockpits with VAPS, while operating in a complete visual environment provided by GVS. Developers of simulation and training systems will now be able to create systems with much higher fidelity at costs which are a fraction of high-end custom-built simulators. Both VAPS and GVS run on the complete family of Silicon Graphics IRIS 4D™ workstations.

For more information, contact: Eugene Joseph, President, Virtual Prototypes, Inc., 5252 de Maison-

neuve Ouest, Montreal, Quebec H4A 3S5, (514) 483-4712 or Dale Stimson, President, Gemini Technology, Corp., 5 Jenner Ave., Suite 165, Irvine, CA 92718, (714) 727-1980.

Advanced 3D Color Digitizing Technology Available

Cyberware's Model 3030 3D color digitizer employs an optical rangefinding technique in which a safe, low-power laser projects a vertical plane of light onto the object. Mirrors pick up the resulting lighted contour on the object from two viewpoints. The use of two contour views significantly reduces any inaccuracies due to shadowing. The views are combined optically, then scanned by a video sensor. Specialized electronics digitize the video image to create a rectangular range map and an array of distance measurements. The digitizer sweeps the plane of laser light around the object, digitizing one contour at a time, until a complete range map has been created to describe the object.

Cyberware digitizers simultaneously collect color information via a second video sensor. The digitizer acquires a color value for each region in the range map and stores this value along the distance data. By marking an object's surface before digitizing, color can be used to transfer ideas from the object to the computer graphics model. In specialized applications, color can reveal characteristics such as skin discoloration, the grain of wood and locations of fasteners. Working in the infrared region, a customized color subsystem can even detect surface temperature. The digitizer transfers the range map into a database on an IRIS workstation via a standard Ethernet link. The acquired data can be viewed immediately after digitizing.

Cyberware's digitizers have been used for applications ranging from reconstructive or cosmetic surgery, CAD/CAM, animation and special effects for films. For more information, contact: Cyberware Laboratory, Inc., 8 Harris Court 3D, Monterey, CA 93940, (408) 373-1441.

Ryan McFarland Announces RM/PANELS™

The Ryan McFarland Corporation has released RM/PANELS, a new development tool for prototyping screens and application interfaces. RM/PANELS requires version 5 of RM/COBOL-85; Ryan McFarland's development system. Written in RM/COBOL-85, RM/PANELS will run on UNIX and DOS systems. Finished applications can be ported to other systems without modification.

RM/Panels brings state-of-the-art programming constructs to COBOL screen handling. RM/PANELS offers the following features: a WYSIWYG screen editor, panel-based field validation facilities, panel-based help screens and the ability to design applications using multiple panels.

For more information, contact: Suzanne Yabsley, Ryan McFarland Corp, 8911 Capital of Texas Highway North, Austin, TX 78759, (512) 343-1010.

Vital Images Releases VoxelView/PLUS 1.4™

The newly released VoxelView/PLUS 1.4 is an interactive volume rendering software system. It incorporates two major additions: a modular, open architecture and a measurement suite. The new release provides users with the capability to design their own interface and to attach these modules to the VoxelView volume

rendering engine. Users can construct their own interface and customize preprocessors. This new modular architecture also allows multiple copies of VoxelView to act on the same data set, enabling users to visualize the data from different viewpoints simultaneously.

Release 1.4 includes the addition of a measurement suite. The measurement suite gives users the ability to perform quantitative measurements on points, lines and areas and save the results. The new release has been enhanced to support the graphics architecture of the IRIS POWERVISION™ series.

For more information, contact: Maggie Vancik, Vital Images, Inc., 505 N. Third St., Fairfield, Iowa 52556, (515) 472-7726.

BioDesign Introduces New Polymer Modeling Software

BioDesign, Inc. has announced the commercial availability of version 2.1 of its POLYGRAF™ molecular software which is capable of building and simulating realistic models of amorphous, crystalline or amorphous/crystalline polymers in periodic systems. Its analysis tools include the ability to apply stress to the bulk model and derive statistically valid properties. POLYGRAF also calculates the electrostatic charges based on the conformation of the molecule and polarization effects by neighbor atoms, rather than using a gross approximation or ignoring these effects. Since the intermolecular electrostatic interaction plays a major role in determining the properties of polymers, dynamic charge equilibration provides a more accurate representation of the polymers.

Other polymer modeling packages will simulate only crystalline or discrete amorphous polymers. Since most industrial polymers have both amorphous and crystalline properties, and since the mechanical properties of bulk polymers are substantially different than those of single chains, POLYGRAF 2.1 represents an advantage toward enabling chemists to reliably design materials with specific properties, prior to engaging into lengthy laboratory synthesis.

For more information, contact: Jeff Marusin, BioDesign, Inc., 199 S. Los Robles Ave., Suite 540, Pasadena, CA 91101, 818/793-3600 or FAX 818/793-8098.

Silicon Graphics Goes to Rio (and the Rest of Brazil)

CDB Computadores S.A. has been selected to be the Silicon Graphics distributor in Brazil. CDB will distribute the entire line of IRIS 4D workstations and servers. Brazil is particularly strong in the CAD/CAM, geosciences and animation areas. The two companies will work jointly on pre-sales and after-sales support, as well as organizing high-quality customer training, maintenance and technical services.

For more information, contact: Jill Grossman, Silicon Graphics, (415) 335-1516 or Jose Adilson de Carvalho, CDB Computadores S.A., (55) (11) 256-1411.

Parallel Computers Unveiled

Silicon Graphics has announced IRIS Power C™ and Power Fortran 2.0™, parallel compilers for the company's RISC-based multiprocessing IRIS 4D Power Series™ graphics and project supercomputers. The parallel compilers allow a single application program to execute faster by running the code over more than one processor simultaneously.

IRIS Power C and Power Fortran 2.0 consist of preprocessing analyzers and multiprocessing compilers. The analyzers examine the source code, determine the regions that can be parallelized, rewrite the original program and insert multiprocessing directives to take advantage of multiple processors. Additional regions can be parallelized by manually inserting the appropriate directives. The directives inserted into the code are commented so that the original source code will remain unchanged. The products also allow the programmer to control the exact number of processors used at runtime to maximize the use of system resources.

For more information, contact: Renee Wildman, Silicon Graphics, (415) 335-1026.

Video Window in Stereo

RGB Spectrum announces the successful application of its video windowing system for stereographic video displays. Martin Marietta is using the RGB/View™ video windowing system for land based, remotely piloted vehicle (RPV) application. Cameras on the RPV transmit live video images via telecommunication links to a remote station from which the driver controls vehicle movement.

Four cameras on the RPV scan the landscape from the moving vehicle. Two cameras transmit a stereo video image; the other two provide standard video images. Video images are transmitted back to the remote console, where the RGB/View video windowing system digitizes them for display in real-time on the workstation monitor. The remote driver sees the

distant landscape reproduced on a wrap-around three part monitor. The central panel displays the terrain directly ahead of the vehicle in stereoscopic 3D. The left and right panels display the landscape on either side of the vehicle. The IRIS 4D workstation generates graphic representations of operator controls such as fuel level and speed. The video windowing controller displays the live video on the computer monitor with terrain maps and targeting locations as overlays. To view the images in stereo, the operator wears a pair of special glasses from StereoGraphics Corporation. Other uses of an RPV type system could include offshore drilling applications or hazardous waste disposal facilities.

For more information, contact: Carol Fogel, RGB Spectrum, 2550 Ninth St., Berkeley, CA 94710, (415) 848-0180.

Video Windowing Controller Board

RGB Spectrum is shipping the RGB/View 500™ video window display controller board which integrates real-time video with text and graphics on an IRIS display. The real-time video is displayed as a window on the screen. The window can be expanded to full screen size, positioned, scaled, clipped, overlaid with computer graphics and digitized for storage and further processing.

The board accepts input from cameras, tape recorders, interactive videodisc, or video teleconferencing system. Primary applications for the RGB/View 500 include image processing, process control, simulation and teleconferencing.

For more information, contact: Carol Fogel, RGB Spectrum, 415/848-0180.

New ColorStation™ Plotter is a Winner

Raster Graphics new ColorStation is an affordable, full-color, large format, laser-quality printer for the visual processing environment. The ColorStation enables one to shorten design cycles, lower overall costs, and produce 24" X 36" color plots in minutes instead of hours. The ColorStation connects to Silicon Graphics' IRIS workstations.

The new color electrostatic plotter can be used as a high-speed replacement for a pen plotter and also as a full color printer, at 200 or 400 dpi. The patented paper transport system takes paper from an easy-to-use roll, cuts it, and anchors it to a belt while the image is written. Once the drawing is complete, the finished output is delivered into the paper catch tray for instant access by the user, a feature that enables the ColorStation to efficiently operate on a network with multiple users. The plotter was awarded the "Best New Product of the Year" award at the 1990 National Design and Engineering Show in Chicago.

Raster Graphics has also introduced a new Plot Management Option™ for the ColorStation. This option now includes the ability to do plot nesting and tiling of HPGL files in addition to providing the ability to plot very large HPGL vector files, to mix vector and raster data on the same plot, and to plot from Autoshade or TARGA applications. The Nesting/Tiling capability is included in the Plot Management Option for all Raster Graphics plotters. It will also be available as a firmware upgrade for existing customers.

For more information, contact: Raster Graphics, Inc., Sunnyvale, CA, (800) 441-4788.

"It would take 500 VAX years to solve this problem."

Silicon Graphics Marketing Services, 707 California Street, Mountain View, CA 94041 • © 1990 Silicon Graphics, Inc. Silicon Graphics and the Silicon Graphics logo are registered trademarks of Silicon Graphics, Inc. All other registered and unregistered trademarks above are the properties of their respective holders. *Based on Dhrystone version 1.1 results relative to a VAX 11/780. **Double Precision Linpack MFLOPS

With Silicon Graphics project supercomputers, it was solved in less than a year.

Fermilab operates the world's highest energy proton accelerator, where particle collision data is recorded and reconstructed. The information gained through these experiments is helping scientists determine the nature of matter.

The time and computing power required to perform these highly complex reconstructions is staggering. Because Fermilab had neither 500 years, nor the budget for 500 VAXes, they enlisted the help of four Silicon Graphics project supercomputers. And, they finished the data analysis within a year.

Parallel RISC, unparalleled performance.

Many companies, like Fermilab, that have compute-intensive tasks are discovering the advantages of Silicon Graphics project supercomputers. In fact, after just one year, Silicon Graphics has become the fourth largest supercomputing vendor, and the fastest growing, by far.

Silicon Graphics project supercomputers provide extraordinary compute power without the high cost of owning a minisupercomputer or a room full of VAXes. And they're far more cost-effective than a time-shared Cray®.

These systems can be configured with up to eight high performance RISC CPUs, in a state-of-the-art parallel architecture. They provide more than 200 VAX MIPS* and over 30 DP MFLOPS** of sustained performance, making them ideal for compute and I/O intensive scientific and engineering tasks.

Silicon Graphics project supercomputers are easily integrated into computing environments through the use of standards like UNIX®, TCP/IP, NFS™, X.11, DECnet™, VMS extensions to FORTRAN, SNA, Ultranet, FDDI, and ACCELR8™ VAX® migration tools.

A few of the organizations that are using Silicon Graphics project supercomputers today:

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Boeing Computer Services
Cray Research, Inc.
E-Systems, Inc.
Electronic Data Systems Corp.
Fermi National Accelerator Lab
Ford Motor Company
General Electric Company
IBM Corp.
Lucasfilm Ltd.
McDonnell Douglas Corp.
Minnesota Supercomputer Institute
NASA
Naval Research Lab
Northrop Corporation
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Texas Instruments Inc.
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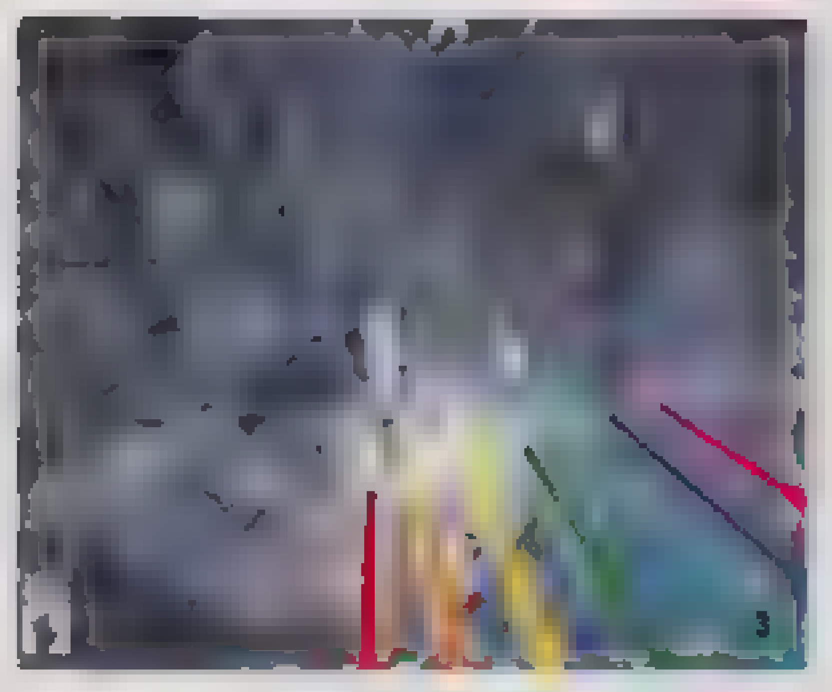



Silicon Graphics Forms Technical Exchange Council

The Los Angeles office of Silicon Graphics has formed the Technical Exchange Council (TEC). The council was designed to function as a formal information channel between Silicon Graphics and advanced users of IRIS computer systems. TEC will provide a forum for discussion of technical issues, facilitate customer feedback and give council members an opportunity to present their opinions regarding the company's plans for the future. Twenty Los Angeles-based customers, representing Rockwell, Caltech, TRW, JPL, Northrop, Aerospace Corp. and others, attended the first meeting held in July. The discussion addressed issues such as networking, the IRIX 3.3 operating system release, CD-ROM, customer support, application plots, graphic standards and programming. Future meetings are planned on a semi-annual basis.

NCGA '91

The National Computer Graphics Association conference and exposition comes to McCormick Place North in Chicago, Illinois, April 22-25, 1991. The conference is dedicated to computer graphics applications. Highlights will include user area sessions on architecture, engineering, graphic design and publishing and manufacturing/operations, hands-on training and computer systems ranging from PCs to workstations to minicomputers.

For more information, contact: NCGA, 2722 Merrilee Drive, Suite 200, Fairfax, VA 22031, (800) 225-NCGA or (703) 698-9600.

Arts and Technology Symposium

This gathering will promote the exchange of concepts and issues between artists and technologists through the presentation of papers, artists' submissions and videos. The dates for the symposium are April 4-7, 1991. It will be held at Connecticut College, New London, Connecticut.

For more information, contact: Prof. David Smalley, Department of Art, Connecticut College, Box 5637, 270 Mohegan Ave., New London, Connecticut 06320-4196.

CHI '91 Conference

The theme of this years' Computer Human Interface conference is "Reaching Through Technology." The conference will be held April 28-May 2, 1991 in New Orleans, Louisiana. Panels, papers, demonstrations and workshops will be featured at CHI '91.

For more information, contact: Judy or Gary Olson, CSMIL, Tappan, University of Michigan, Ann Arbor, MI 48109-1234, (313) 747-4948.

The images on these two pages were selected from the 300 entered in the First International Visual Processing Awards. All were created on IRIS workstations.

1. One frame of an animation depicting the fluid dynamics of a paint splash. *XAOS Computer Animation and Design*, San Francisco, California
2. A view of Antonio Gaudi's Church of the Sagrada Familia *Animatica*, Barcelona, Spain.
3. A frame from an animation sequence of the station identification for Swiss Television. *De Beeldenstorm*, Amsterdam, The Netherlands
4. & 5. Frames from an animation sequence. *XAOS Computer Animation and Design*, San Francisco, California.
6. A water strider. *Softimage*, Montreal, Canada
7. A reflective metal ball created with a "homemade ray tracer in C." *Lawrence Kesteloot, George Mason University*, Washington, D.C.

IEEE Conference on Computer Workstations

IEEE's Third Conference on Computer Workstations will focus on current accomplishments and future challenges for workstations. The conference will take place in Falmouth, Massachusetts on May 15-17, 1991.

For more information, contact: Keith Marsullo, Program Co-Chair, CCW '91, Department of Computer Science, Upson Hall, Nornell University, Ithaca, NY 14853.

Solid Modeling and CAD/CAM Symposium

ACM/SIGGRAPH is sponsoring the Symposium on Solid Modeling Foundations and CAD/CAM Applications to be held June 5-7, 1991 in Austin, TX. The objective of this symposium is to provide a forum for the exchange of research results both in the applications of solid modeling to CAD/CAM, and in the underlying algorithms, data structures and software engineering methodologies of solid modeling systems.

For more information, contact: Jaroslaw Rossignac, IBM Research, J2-CO3, P.O. Box 704, Yorktown Heights, NY 10598, (914) 784-7630.

USENIX '91 Goes Multimedia

The USENIX '91 summer technical conference and exhibition has chosen "Multimedia — for Now and the Future" as its theme. Join the USENIX at the Opryland Hotel in Nashville, Tennessee, June 10-14, 1991. The conference will provide a variety of forums in which participants can explore multimedia issues as well as more general operating system and environment questions. Systems designers and multimedia developers will explore the challenges of how to support and deliver new types of interfaces — voice, video, animated graphics, touch and music.

The conference schedule of events includes: a tutorial program, technical papers, multimedia presentations, panel discussions and the technical exhibition. For more information, contact: the USENIX Conference Office, 22672 Lambert St., Suite 613, El Toro, CA 92630, (714) 588-8649.

CG International '91

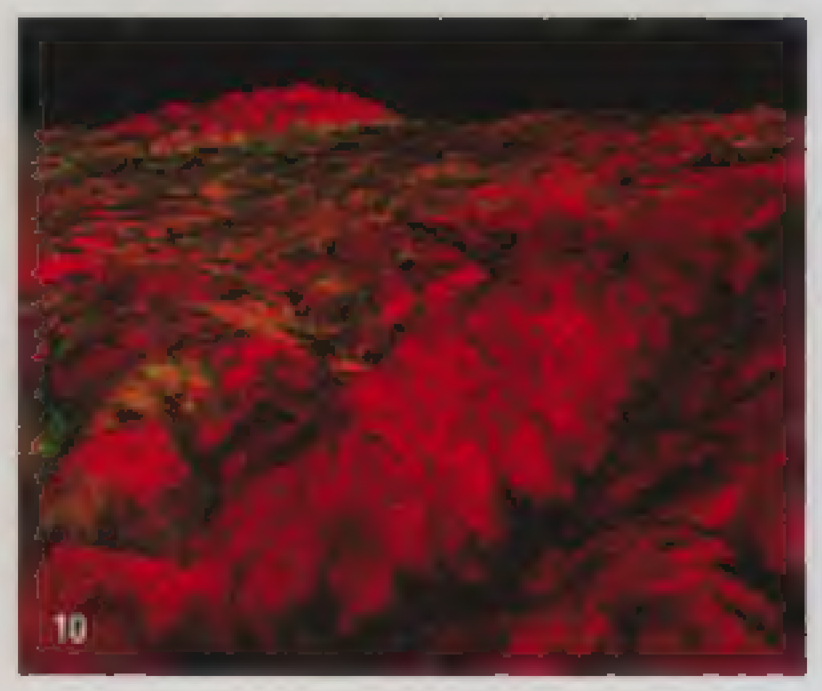
CG International '91 will be hosted in Cambridge, MA by the Computer Graphics Society and the Massachusetts Institute of Technology. The conference will take place June 22-28, 1991.

For more information, contact: N.M. Patrikalakis, Program Chair for CGI '91, MIT, room 5-428, 77 Massachusetts Ave., Cambridge, MA 02139, (617) 253-4555 or email: nmp@deslab.mit.edu.

SCSC 1991

Enhancing simulation utility is the emphasis of the 1991 Summer Computer Simulation Conference to be held at the Hyatt Regency Hotel (Inner Harbor), Baltimore Maryland on July 22-24, 1991. The conference will feature innovative presentations, panel discussions, state-of-the-art reviews, tutorials and trade show exhibits designed to provide comprehensive coverage of the field of computer simulation. Some of the topics to be covered include: intelligent simulation environments, robotics, biomedical sciences, aerospace simulations and undersea systems.

For more information, contact: Brian O'Neil, Society for Computer Simulation, P.O. Box 17900, San Diego, CA 92117, (619) 277-3888.



8. This picture consists of four quadrants, all of which are the same image of an agricultural area in Manitoba, Canada. The four quadrants show the LANDSAT satellite visual data in different stages of processing. *Geostudio Consultants Ltd.*, Ottawa, Canada.
9. A modified image based on a photograph taken from the Japanese Marine Observation Satellite (MOS). *Geostudio Consultants Ltd.*, Ottawa, Canada.
10. An image based on a LANDSAT photo that was then modified with color and elevation data, *Softimage*, Montreal, Canada.

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SILICON GRAPHICS, INC. EDUCATION CENTER COURSE CALENDAR

Through June 1991	LOCATION*		
4D SERIES COURSES	**WEC**	**EEC**	**SEC**
Graphics Programming 4.5 days	Mar 18, 1991 Apr 22, 1991 Jun 3, 1991	Mar 4, 1991 Apr 8, 1991 May 20, 1991 Jun 17, 1991	Apr 15, 1991 Jun 10, 1991
Power Vision Graphics Programming 2.0 days	not available	not available	not available
Advanced Graphics 3.5/3.0 days	Jun 10, 1991	Apr 15, 1991 Jun 24, 1991	Mar 4, 1991 Jun 17, 1991
Advanced Graphics & Power Vision 4.5 days	Mar 25, 1991 Apr 29, 1991	not available	not available
Parallel Programming 4.5 days	Apr 15, 1991	not available	not available
Mastering IRIX 4.5 days	Apr 15, 1991 May 13, 1991 Jun 10, 1991	Mar 11, 1991 Apr 22, 1991 Jun 3, 1991	Mar 11, 1991 Apr 29, 1991
System Administration 4.5 days	Mar 4, 1991 Apr 22, 1991 May 20, 1991 Jun 17, 1991	Mar 18, 1991 May 13, 1991 Jun 10, 1991	Mar 18, 1991 May 6, 1991 Jun 24, 1991
Network Administration 4.5 days	Apr 29, 1991	Mar 25, 1991	not available
System Maint. Professional Series 10.0 days	not available	Apr 29, 1991	not available
System Maintenance Power Series 4.0/10.0 days	Mar 4, 1991 Jun 17, 1991	not available	not available

KEY: WEC—Western Education Center, Mountain View, CA.
EEC—Eastern Education Center, SGI Federal, Bethesda, MD.
SEC—Southern Education Center, Dallas, TX.

*The SGI Education Center reserves the right to cancel classes due to insufficient enrollment.

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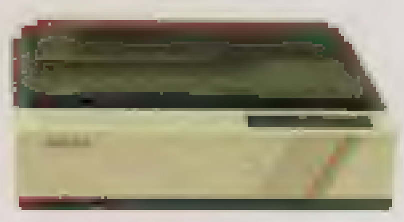

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Without Alias Animator, the Pseudopod would have been a puddle.

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